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YOUR COMPUTER

OCTOBER 1982 BRITAIN'S BIGGEST – SELLING HOME COMPUTER MAGAZINE Vol.2 No.10

Trooping the colours: we review the new Sanyos, MPF-II, Vic-64 and Colour Genie

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EDITORIAL

IF THE WRITING is on the wall for British micro manufacturers, most of them have been too busy composing delayed-delivery letters to notice it. Even if they had, they might not have understood the inscription — which would probably be in some oriental tongue. U.K. micro-makers should take heed of the machines which are beginning to flow in from overseas — and from the Far East in particular — if they want to avoid the complacency which has cost other areas of British industry dominance of their home market.

The new wave of micros reviewed in this issue — Sanyo's PHC range, the MPF-II from Taiwan, the Commodore-64, and the Colour Genie from Hong Kong — may not topple the British manufacturers' sandcastle, but then they are only the first ripples of a rising tide. Given the innovations by British firms in low-cost home computing, it would be a shame if production problems and poor reliability lost them the lead. These are exactly the areas where foreign manufacturers, particularly the Japanese, make sure they never put a foot wrong.

In the early 1970s, Clive Sinclair produced the world's first wristwatch with all its electronics on a single chip. His Black Watch failed in the face of Japanese competition because of poor reliability and late deliveries. He and other British innovators are unlikely to meet the same fate, saved this time by the volume of software available for their machines. The fact is that the cost of a micro is a relatively small part of the price one must pay to start computing — the software accounts for the rest of it. If the overseas manufacturers produce the right software they will begin to dominate.

If you have waited 12 or 14 weeks for a ZX Spectrum or a BBC model B — or worse, you are facing more delays because your first, long-awaited micro proved faulty and had to be returned — you have little choice but to go on waiting. With an influx of foreign machines anyone confronted with a situation like that would simply go to the nearest High Street electronics store and buy something reliable off the shelf. It would be a sad irony if one were able to buy a machine from Japan, Hong Kong or Taiwan more easily than from Camberley or Kettering. ■

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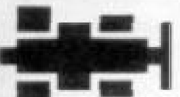
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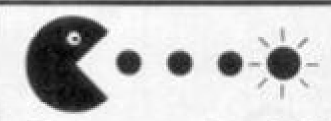


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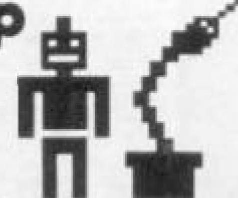
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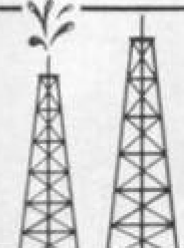
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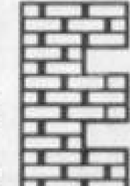
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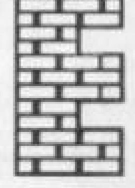


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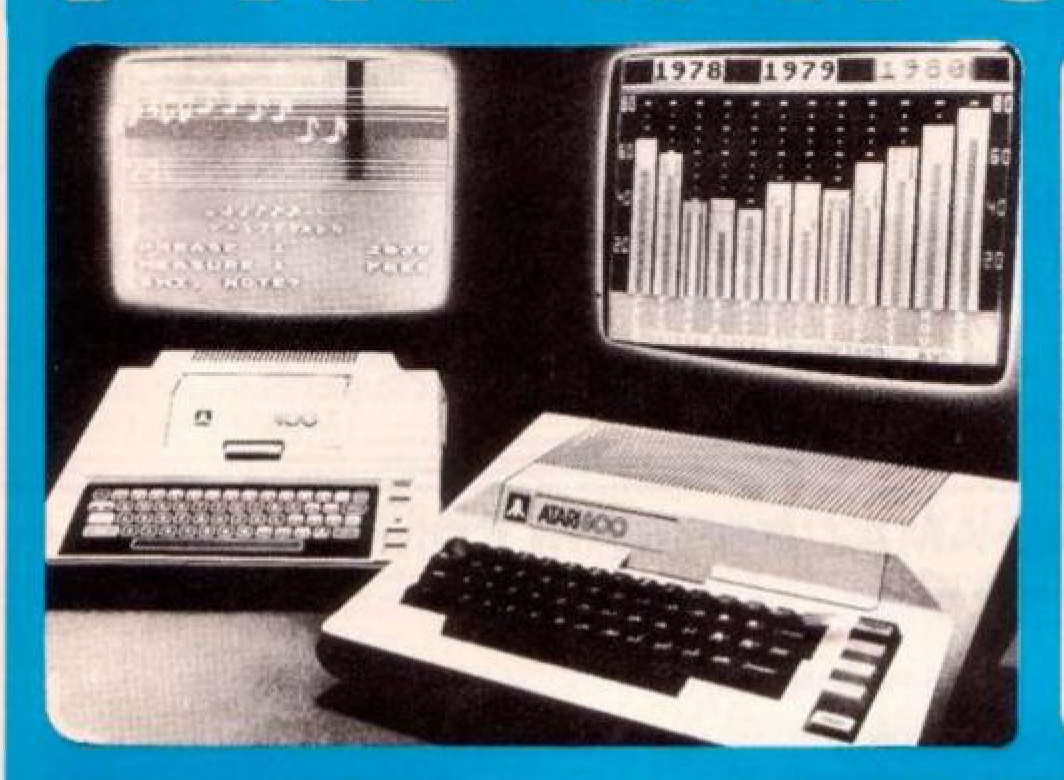
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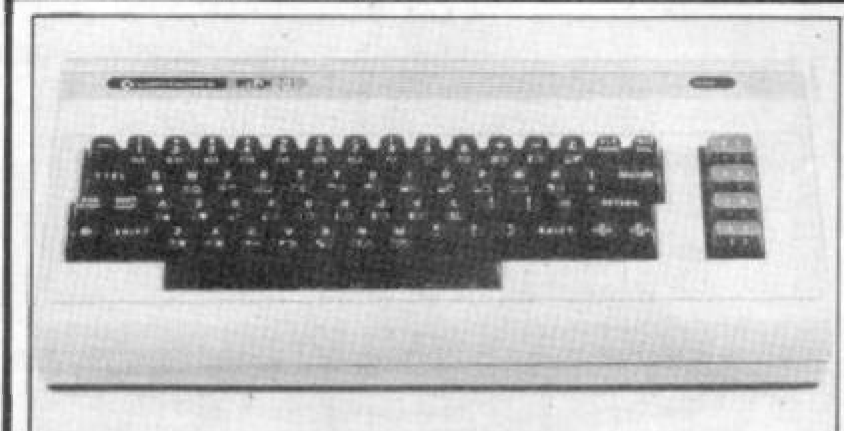
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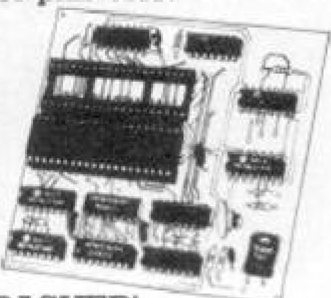
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- 24 x 32 character flicker-free display.

The Jupiter Ace uses FORTH

The Ace is set apart from all other personal computers on the market by its use of a revolutionary language called 'FORTH'. Some computer languages are easy for humans to understand, others are easy for computers; FORTH is most unusual in being both. Its underlying principles are so simple that it takes even a newcomer to computers only a few minutes to learn how to do calculations on the Ace, yet the very same principles are powerful enough to allow you to invent your own extensions to the language itself.

At the same time, the memory-saving coded form used to store your programs inside the Ace allows it to obey them very fast — typically in less than a tenth of the time it would take to do the same thing using a different language. Amongst other things, this makes the Ace ideal for games.

FORTH's unique combination of speed, versatility and ease of programming has already made it a prime choice for professional applications as diverse as pub games and radio telescopes, and gained it an enthusiastic national user group. Now the Jupiter Ace can bring this addictive language into your own home.

Designed by Jupiter Cantab

Leading computer Designers Richard Altwasser and Steven Vickers have a reputation for pushing technology forwards. After playing the major role in creating the ZX Spectrum they formed Jupiter Cantab to develop their latest brainchild the Jupiter Ace.

Technical Specification

Hardware

Processor/Memory
Z80A running at 3.25 MHz. 8K bytes ROM 3K bytes RAM.

Input
40 moving-key keyboard with auto-repeat on every key.

Output
Memory-mapped 32 x 24 character display with high resolution user graphics. Output to drive normal UHF TV set on channel 36.

Sound
Provided by internal. loudspeaker.

Cassette
Load Save & Verify at 1500 baud, separate data storage.

Software, FORTH

Data Structures
Integer, Floating point and String data may be held as constants, variables or arrays with multiple dimensions and mixed data types.

Control Stuctures
IF-THEN-ELSE, DO-LOOP, BEGIN-WHILE-REPEAT, BEGIN-UNTIL, all may be mixed and nested to any depth.

Operators
Mathematical +, —, X, ÷.
Logical AND, OR, NOT, XOR.
Comparison <, >, =.

Program Editing
FORTH words may be listed, edited and redefined. Comments are preserved when words are compiled.

Order Form

The **Jupiter Ace** is available only by mail order. Please allow up to 28 days for delivery.

Send cheque or postal order with the form to:—

JUPITER CANTAB, 22 FOXHOLLOW, BAR HILL, CAMBRIDGE CB3 8EP

Please send me:—

☐ JUPITER ACE MICROCOMPUTER(S) @ £89.95.

Name. Mr/Mrs/Miss

Address

F

DUNGEONS POKE

There was yet another high-quality ZX-81 machine-code program in the August issue of *Your Computer* — J Chalmers' Dungeons — but after painstakingly entering the hexadecimal, I found that, on Running, an error code 5/0 appeared at the bottom of the screen.

I set about unravelling the Print Room routine and discovered the mistake; the final two bytes of 16 should read

06 09 1D B, 9

The simple remedy to my problem was to enter: Poke 16937, 9 as a direct command.

I hope that more ZX machine-code programs will be seen in the future issues, including ZX Spectrum programs, but has anyone found an easy way to manipulate the display file of the Spectrum? The peculiar three-sections layout has me puzzled. Is there some hidden advantage, possibly for the Prestel interface?

J Ratcliffe,
Leicester,
Leicestershire.

SPEED BALL

When I entered Speed Ball on my machine, it did not run properly and crashed when I came too close to the left hand corner. I finally found the error was not in the machine code proper but in the bytes before. The answer is to run the program in Slow, and Poke 16534 to 16537, 16540, 16541 and 16544 to 16548 with 8. 16548 is not a minus sign but 8 again.

How do you obtain random positions in a machine-code program? Most of the balls originate in the left-hand corners.

R Vanhove,
Merelbeke,
Belgium.

ALARM SOUNDS

There were a few mistakes in the listing for Sounds of Alarm in the August edition, page 85. Here are the corrections.

```
 4 POKE36879,8 : GOSUB 40
25 PRINT "SQQQTIME"
33 PRINT"0)))))))"; left£(AL$,2);
   ":";MID$(AL$,3,2)":";RIGHT$
   (AL$,2)
37 GOTO 25
```

S will clear home, Q brings the cursor down, O brings the cursor up and) moves the cursor right.

David Harmes,
Walton,
Derbyshire.

BEEBOX PET

With regard to the article on Vic memory expansion in the August edition, I would like to draw your attention to the following points: the Beebox has the facility to operate as a 40 column Pet (minus Pet graphics), but in colour. No mention of this was made in the article. It is true that the unit has been designed to accept a Prestel adaptor unit, Acoustic Mode, for communicating with British Telecom computers, and the standard ASCII codes have been used. No claim has been made that this unit runs as Prestel.

The author states the unit worked with the Beelines monitor, but not with his TV. The Beebox monitor is RGB and the Beebox gives out RGB at TTL level and composite video at 1V P.P on 75Ω.

You must either modulate the video up to RF to enable reception on a domestic TV, or encode the RGB to PAL and then modulate or display on a video monitor.

Roy Briant,
East Sheen,
London.

SELLING POINTS

I have been looking into buying a new home computer. I have a ZX-81 at present, and have been reading reviews of the other more popular micros. I find the choice bewildering. As a result I have formed a comprehensive list of desirable features with a rating of 1 to 10 on each feature.

Features	Rating 1 to 10
Motor control	7
Data files on cassette	8
Reliable loading	9
Verify	6
Merge programs	7
If-Then-Else, on-goto, On-gosub, multi-statement lines	8
25 × 40 screen	6
>192 × 256 resolution	7
User-defined graphics, Functions, keys	7
Printer, disk, etc, capability	8
>16K RAM, preferably 32K	8
Line and circle plotting	8
Joysticks, paddles, light-pens	7
Plug-in cartridges	3
Software available	5
Other languages than Basic	8
Screen editing	7
Auto repeat on all keys	7

J Gardner,
Dalebrook,
Burton on Trent.

WRIT LARGE

The following program is written for the standard Vic-20 or the Vic-20 with 3K RAM pack:

```
10 POKE51,256:POKE52,19:POKE
   55,256:POKE56,19:CLR
20 FOR I=0TO1024:POKE5120+I,
   PEEK(32768+I):NEXT
30 FOR X=0TO512:A=PEEK
   (32768+X)
40 POKE6144+2*X,A:POKE
   6145+2*X,A:NEXT
50 POKE36869,253:POKE36866,PEEK
   (36866)OR128
```

The double-height characters take the place of the reverse characters in the character set. The characters may be Poked or Printed on to the screen.

CTRL-RVS$^{B}_{C}$ will create a large letter "A", or CTRL-RV$^{D}_{E}$ will produce a large "B".

The Poke codes for the double-height characters are from 128 to 255. Hence:

POKE7680,128:POKE7702,129

will produce a double-sized @ at the top-left of the screen. Because the program reserves 2K of memory, only just over 1K is available to the user, unless a 3K expander is attached.

A Kavanagh,
Sutton Coldfield,
West Midlands.

THE LONG WAIT

I just had to let you know it is three whole months since I placed a telephone order for a 48K Spectrum. I offer no prizes for guessing how I feel about this situation.

I remain a firm believer in the Spectrum and the thought of the Microdrive keeps my order with Sinclair — for the moment.

However, I would like to offer one warning to Sinclair, if I may be so bold. Japanese industry has shown its abilities in both our motor cycle and motor car markets. It will not be very long before they enter our home computer market, and if the past performance in terms of delivery and back-up service to the consumer are not greatly improved upon by Sinclair Research, I believe they will very quickly become an example of the best-forgotten side of British industry.

P Bloxham,
Loughborough,
Leicestershire.

SPECTRUM BUGS

When my Spectrum finally arrived, I discovered a couple of interesting bugs. Type

CLS:PRINT CHR$ 8;"x";

Two black squares appear on the far right of the screen. If you alter the "x" to other letters for example "b", you get some interesting results.

The other bug is even stranger. Type the following as a direct command:

```
FOR F=1 TO 100 STEP 0:PRINT
"o":NEXT F
```

When the computer asks "scroll" press Caps shift and Symbol shift together. You will get your command back again. You cannot keep it though, for when you press any key, a lot of half-finished keywords, such as Randomiz, are printed on the screen. I wonder how many other bugs there are.

Stephen Dixon,
1 Collaton Road,
Leicester LE8 2GY.

MEMORY SAVER

Tim Hartnell's reply to Nick Flint's enquiry on random movement in August Response Frame prompts me to donate a version of this type of subroutine where plus or minus one is allotted to Print At co-ordinates.

Try:

```
10 LET X = PI * PI
20 LET Y = X
30 PRINT AT X, Y:" "
40 LET X = X + SGN (RND-RND)
50 LET Y = Y + SGN (RND-RND)
60 PRINT AT X, Y: "*"
70 GOTO 30
```

This halves the usual amount of memory needed to achieve the same effect. If −1, 0 and + 1 are needed, then try

LET X = X + INT (RND*2−RND)

Keeping in mind that Plot and Print at round to the nearest integer, byters on a 1K diet may make use of LET A = COS PI (= −1), NOT PI (=0), SGN PI (=1), SQR PI (=2), PI (=3).

For other uses INT PI gives an integer 3. Thanks for the help I have had from your excellent magazine.

Brian P Johnson,
Pimlico,
London.

ATOM FILE

For a long time now I have been working on a file-handling program for my Atom. The Basic search routine is so slow! George Byrns' article on machine-code filing routines in August *Your Computer* was most handy.

However, having typed in the programs I found the data was being deposited throughout my program, overwriting the Basic text. The following attentions are required:

```
1000 ! # 80= # 00008205
1550 PRINT "5. . . . . . . DELETE
     RECORD" '
4050 IF ?S=CH ":" THEN GOTO 4090
4070 IF ?T=CH":" THEN GOTO 4090
8020 PRINT & # 8205 + ?# 87*? # 84,'
LL18 Again   LDA (88), Y
             CMP 013
             BEQ LL21
             CMP (85), Y
             BEQ LL19
             CLC
             LDA 88
             ADC 01
             STA 88
```

Note: all assembler addresses are in hexadecimal.

Simon Stroud,
Basingstoke,
Hampshire.

MICRO WIDOW

My husband's computing, I'd best beware
"That's it!" he yells out — I leap up with glee
"You have finished?" I ask, "We can watch some TV?"
"No — the program has gone!" he cries in despair
I wish the micro would likewise, in thin air
He loads the machine at lunch, dinner and tea
Is up late at night to one, two and three
Fixing the box with a permanent stare
As wife number two, I'm resigned to my fate
Till he has conquered this thing I now hate
Maybe I could break it, then blame the cat
Far too dishonest, I couldn't do that
The irony is, I'm sure you'll agree
This monstrous computer was a present from me.

Anon ■

Blake's Seven beware — £99 Oric has 16K and built-in explosions



WITH 16K, high resolution colour, and sound the Oric I appears to offer more than any other computer under £100.

Oric Products International is launching the machine this month and expects to sell at least 50,000 of them.

The £99 Oric offers 16K of RAM, 28 by 40 screen layout, 240 by 200 high resolution and 16 colours. There is also a 48K version for £169. Both run on Microsoft Basic and are priced to undercut rivals such as the Spectrum.

The sound facility improves on the Spectrum by supplying one noise and three voice channels. In addition to two enveloping commands it gives a range of pre-programmed sounds like explosions and laser zaps.

Other features include a Centronics printer interface, teletext screen compatibility and a choice of two character sets. By moving the alternative character set — containing mosaic graphic characters — into RAM up to 255 characters can be defined by the user.

The Oric is manufactured by Tangerine Computer Systems, who produced the Microtan kit and the Tantel adaptor.

Fun to learn with Spectrums

SPECTRUM OWNERS will not be short of software support from the manufacturers. Sinclair have released the first set of 21 cassettes for the Spectrum, developed for them by Psion and ICL. The ICL range includes five games cassettes at £4.95 and a Fun to Learn series at £6.95.

Among the Psion range are a 48K chess program for £7.95 and two full-length games, Space Raiders and Planetoids, at £4.95 each. All the new cassettes are now available by mail order from Sinclair Research, Stanhope Road, Camberley, Surrey.

Vicsoft — test your own IQ

COMMODORE has set up the Vicsoft Club to market inhouse programs and accessories as well as products from other companies like Bug-Byte, Adda, ASK and Stack. For £5 members receive an illustrated catalogue and discounts on selected products.

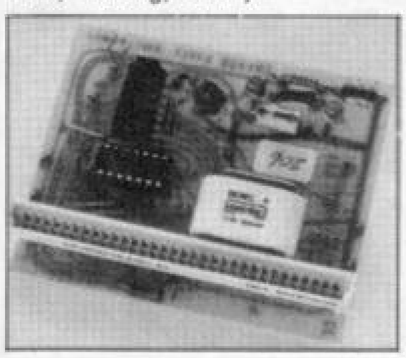
Among Commodore's latest batch of software are some O-level revision programs for English language, mathematics and the sciences; a series of five adventure games or "mind fantasies" as Commodore describes them; and programs to test your IQ and personality. These last two are based on the ideas of Professor Eysenck — not universally accepted in the world of psychology.

Vicsoft is at 818 Leigh Road, Trading Estate, Slough, Berkshire.

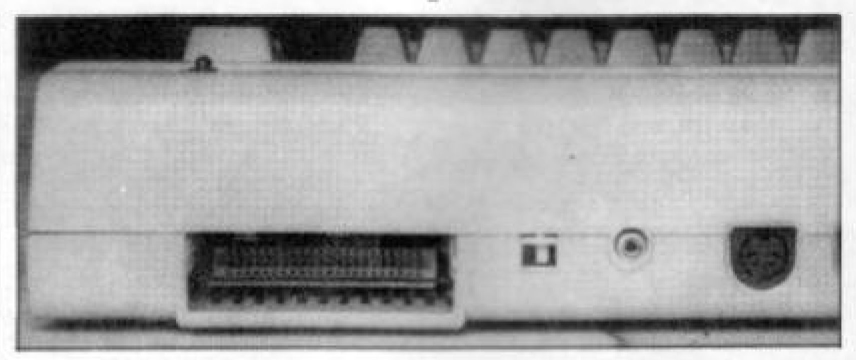
Othello note

WE HAVE been asked, by Mine of Information Ltd, to point out that it is the proprietor of the registered Trade Mark "Othello" in respect of printed matter relating to computer programs.

This real-time clock and calendar fits inside the Atom case and can run for six months on a back-up battery. The price is a bit steep at £40 inclusive of postage and packing, but it also provides a separate interrupt output for control applications. The board is available from Varuna Electronics, Hornsell Park, Woking, Surrey.



Simons finds it simple to answer Commodore's $64,000 questions



DAVID SIMONS, a 16-year-old schoolboy, writes machine code like other people write Basic. He started computing four years ago on an early Pet. Commodore was impressed by some extensions he made to Pet Basic and lent him a Vic-20 to write a demonstration program.

After taking a look at the extra Basic commands offered on other micros, Simons decided to improve Vic Basic by adding the same features. In a remarkably short time he wrote an 8K machine-code program which extends the resident Basic's list by over 60 new terms.

When the first pre-production models of the Commodore-64 arrived from the US nine months ago, David Simons set about mastering the machine, virtually unaided by documentation. Now he probably knows more about the 64 than anyone else in Britain.

He has completed a 16K version of his Basic extension for the 64, which Commodore will be releasing within the next two months. They had originally intended to produce a Super Expander cartridge for the 64 but shelved the idea when they saw the Simons package.

Simons Basic adds 108 commands to the Commodore-64's vocabulary. It incorporates all the features present in more extensive Basics — like If-Then-Else, Repeat-Until, definable procedures — and many of the facilities, such as Dump and Trace, given by utility programs.

Other features are unique to this package. To mention just a couple, it allows you to set the speed at which a program is listed and even to protect a program by suppressing its listing.

In addition there are a number of commands which handle and enhance horizontal scrolling: high-res graphics, sound, sprite graphics, multi- and extended-colour modes. On the standard 64 these areas can only be accessed through Pokes.

Simons Basic will come in ROM on a plug-in cartridge. Commodore has guaranteed 10,000 sales in the first year and will pay David Simons £1 royalty on each sale. Another company, Honeyfold, hope to release the 8K version for the Vic-20.

Open Forth channel now

INTEREST IN Forth is gathering momentum and supporters of the language will be encouraged that the new Jupiter Ace supplies Forth rather than Basic in ROM. Forth is an unusual programming language which can be tailored to fit specific applications. It runs faster than Basic — 10 times faster, for example, than ZX-81 Basic — and occupies far less program memory. When a new command is defined, it is compiled and added to a dictionary of existing commands.

The language is now available for the ZX-81, Atom, BBC and Vic. Artic Computing, 396 James Reckitt Avenue, Hull, North Humberside, supplies ZX Forth on cassette for £35 or on two 4K EPROMS for £69.95. Acornsoft, 4a Market Hill, Cambridge CB2 3NJ, offers versions for the Atom and BBC on cassette for £11.50 and £7.50. A ROM cartridge version for the Vic-20 costs £38.95 from Adda Computers, 14 Broadway, West Ealing, London.

Sinclair's £15 million for education — 25 percent off next buy is the bait

EVERY PRIMARY SCHOOL that orders a Spectrum under the government's Micros in Primaries project will receive from Sinclair a free ZX printer, free copy of Logo computer language and ten vouchers, each worth £45 off the price of a 48K Spectrum.

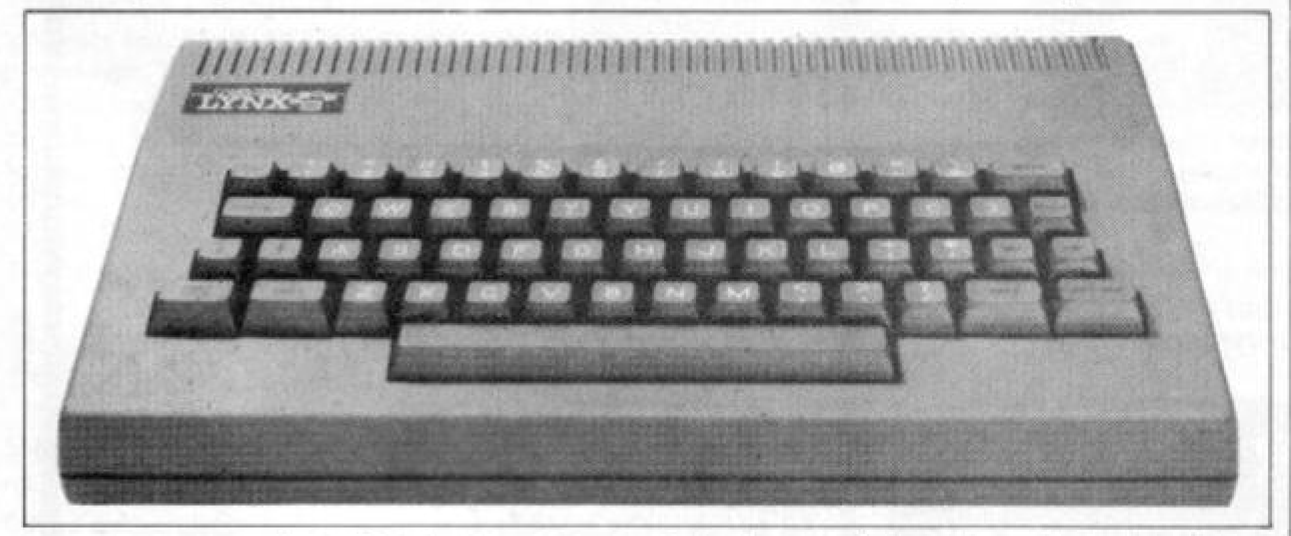
Clive Sinclair claims that "we and we alone have a suitable printer for primary education", and also feels that providing each class with one computer is not much use: ideally, each child should have a computer. He is prepared to spend £15 million on the project.

Sinclair will also release a range of educational software through ICL to complement the government's 150-program library and is already working with Possum Controls to produce a version of the Spectrum for physically handicapped children.

Unabashed by delivery delays of up to three months for Spectrums, Sinclair promised to deliver micros to schools within six weeks and claims general deliveries will also be back on "a 28-day order pattern by early October".



Camputers' 48K colour Lynx will help you work, rest, and play



CAMPUTERS' LYNX calls itself "a serious machine at a remarkably low price". It is certainly the cheapest off-the-shelf 48K computer to have a real keyboard, colour and sound.

By the end of the year Camputers will be offering disc-drives, printers and other add-ons as well as the basic machines.

The Lynx carries 48K RAM, expandable inboard to 192K, and costs £225. Built around a Z-80A microprocessor with an RS-232 port as standard, it is compatible with CP/M software and so may be suitable for business applications as well as home use.

Eight colours can be displayed on a screen of 24 lines by 40 characters and also in the 248 by 256 high-resolution mode. Memory expansion will boost the display to 80 characters a line and resolution to 248 by 512.

Camputers which makes the Lynx claim that the Basic is easily expanded or modified and incorporates several commands to allow machine-code routines to be inserted. A machine-code monitor with 26 commands is tagged on the end of Basic. The Lynx also incorporates a digital-to-analogue sound facility.

ZX conversion made easy

ZX-81 OWNERS who have graduated to the Spectrum do not need to write off all their ZX programs and add-ons. The Adam Adaptor enables you to double the Spectrum's memory to 32K by connecting your ZX 16K RAM pack. Devices such as sound boards which make use of the memory space above 16K can also be run on the Spectrum through the adaptor. It is available from Stephen Adams, 1 Leswin Road, London N16 7NL, for £7.

The Slowloader program converts ZX-81 programs to Spectrum Basic. Machine code routines outside the Basic program area translate ZX-81 code as it is read in from tape. Inverse characters, for example, are changed to normal characters, while the user is given the option of converting half-tone graphics to full-tone or user-defined characters. The Slowloader comes on cassette for £10 plus 45 pence postage from East London Robotics, Finlandia House, 14 Darwell Close, East Ham, London E6. Telephone: 01-471 3308.

Multi-role Max Christmas launch

"A RETAIL-ORIENTED, games-playing computer" is how Commodore describes the Max. After months of rumoured launches and cancellations the machine will finally appear in the shops around Christmas for £100. The Max is like a skeleton Commodore-64. It uses the same video and sound chips and has the same sprite and high-resolution graphics and sound generator but it lacks the real keyboard of the 64.

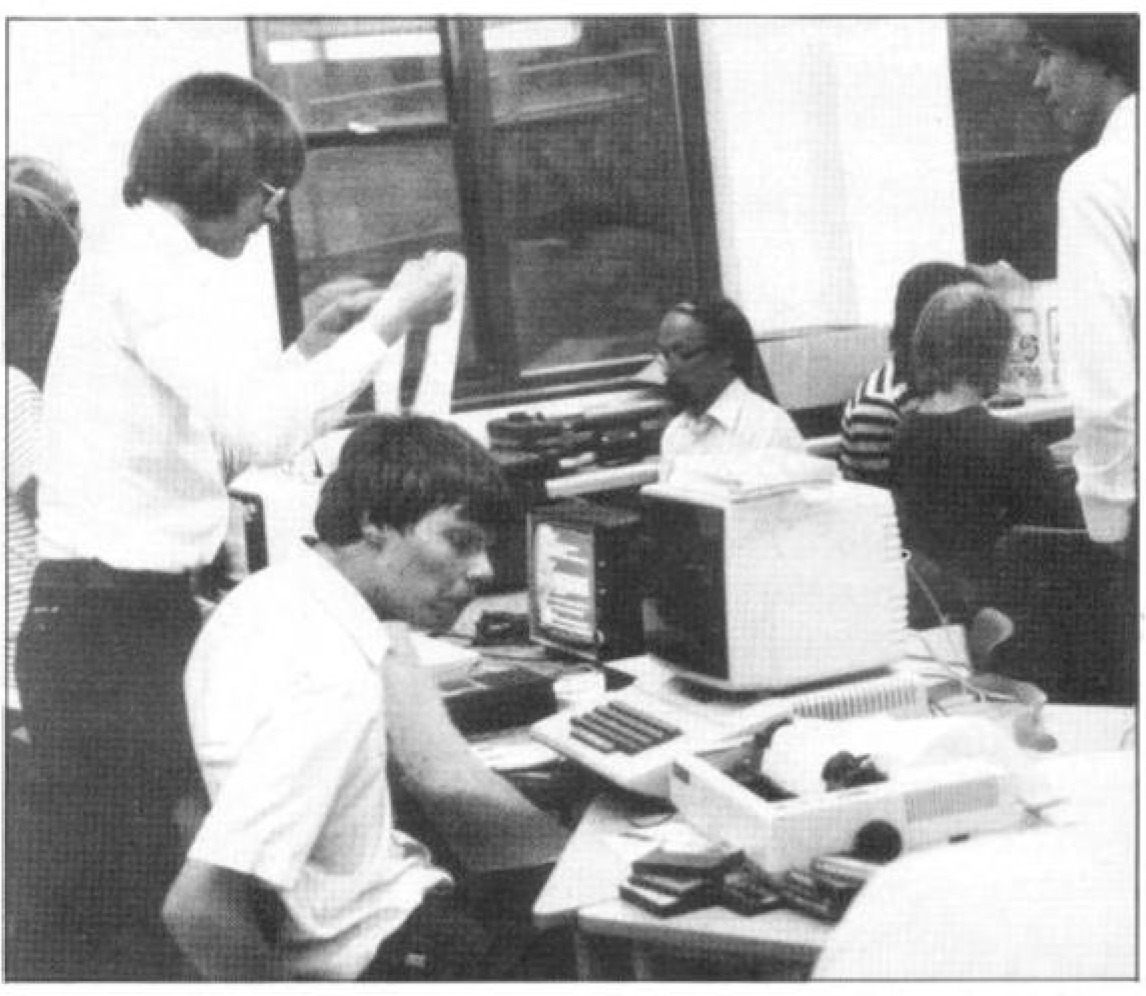


With only 2K RAM and no resident Basic, the Max will need plug-in cartridges to bring out its potential. A mini-Basic is available on cartridge, which increases the memory to 4K, but lacks arrays and trigonometric functions. Commodore claims that Max has three roles: as games machine, music synthesiser and home computer. But probably only beginners will be interested in its programming possibilities.

Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.

Rush-hour in Milton Keynes

From aiding a handicapped child, to building a robot dog, the Milton Keynes Micro-computer Users' Group is involved in a variety of interesting projects. The club is also writing software for educationally subnormal children, to be used on a micro in a local school. Simon Beesley looks at micro-computer developments in one of the U.K.'s youngest towns.



EARLY AUTUMN can be a slack period for computer clubs, but Milton Keynes Micro-computer Users' Group still managed to attract more members to their weekly meeting than most clubs draw in a month. Nearly 40 people turned up for an informal session.

Founded nearly a year ago, the club grew out of a Tandy users' group and now boasts 126 enrolled members. TRS-80 owners are well catered for: Keith Blout, club secretary, has collected a library of programs which members have typed in from magazines and put on tape. Video Genie, Atari, BBC Micro, UK-101 and ZX-81 are some of the other machines owned. A single Spectrum made a fleeting appearance before developing a hard-ware fault.

John Chewter, founder and club chairman, attributes their success to the way meetings are organised. The formula is to offer three types of session, in separate rooms, at each meeting.

One room has been set aside for courses. A course in Basic for beginners centred on a project to write a program listing and assessing the results of the local Darts League. Future courses will cover advanced Basic and machine code.

K-9, lost to *Dr Who* fans some time ago, may be making a reappearance in the club's hard-ware section, where members are building a robot dog. In another project the club hopes to be able to help a 10-year-old handicapped girl, who cannot speak and can only move her head. They intend to give her the chance to communicate through an Apple by linking it up with a smaller ZX-type click keyboard. Also in the pipeline is a scheme to write software for an ESN school. Although the school has a micro, there is very little software available for educationally-subnormal child-ren; a state of affairs the club hopes to remedy by building up a bank of graphic routines.

The third room is given over to more informal computing activities. When we visited the club, so many members were plugging in their machines, power points began to be in short supply. A visitor can wander in and gain hands-on experience on a range of machines, talk to members, or else try out a variety of computer games. The club hires out a ZX-81 to beginners for £1 a week.

Meetings take place every Tuesday at 7.30 pm at Sir Frank Markham School, Woughton Campus, Woughton, Milton Keynes. The club is also planning the occasional whole-day session on Saturdays to be tied in with the local Microtechnology Centre. For more details ring Keith Blout on 0604-402460. ■

Local society news

South Yorkshire

THE SOUTH YORKSHIRE Personal Computing Group meet on the second and fourth Wednes-day of each month. A formal meeting with a talk or demonstration is held at the General Lecture Theatre, St George's Building, Mappin Street, Sheffield. A more informal session takes place at the second meeting in the University of Sheffield's CTS Club, Favell Road. In the middle of this month, the group will be running their annual competition with prizes for software and hardware applications. For more information ring S Gray on 0742 351440.

Edinburgh

EDINBURGH'S ZX Computer Club is flour-ishing. They recently organised the first Scottish ZX Computer Fair and their member-ship now stands at over 70. As well as organis-ing tutorial groups on topics ranging from ele-mentary Basic to advanced machine code, they publish a bi-monthly newsletter. Meetings take place every second and fourth Wednesday in the Claremont Hotel, Claremont Crescent, Edinburgh from 7.30 pm onwards. Ring Keith Mitchell on 031-661 3183 for more details.

Worcestershire

COMPUTER owners in the Worcester area are welcome at the Old Pheasant, New Street, Worcester, where the Worcester and District Computer Club meets on the second Monday of every month. No single make of computer predominates and the club aims to cater to interests in as many different models as possible. D J Stanton will answer any queries on 09025 22704.

Newcastle

IAN KIRTON is interested in starting up a users' group for Dragon owners in the North-East, based in Newcastle. Since the only outlet for Dragons in Newcastle has already sold 87 of them there could be a good response. If enough users telephone him on 0632 814215, he will organise a first meeting shortly.

The new Dragon 32. So well designed, you'll even understand this ad.

If you're already a computer expert, may we refer you to the box of technical specifications displayed opposite.

If you're not, may we refer you to the new Dragon 32 Family Computer. A computer so easy to understand, you won't understand why all the others seem so difficult.

And the new Dragon 32 costs under £200.

32K RAM FOR UNDER £200?*

When you're comparing computers, the first thing you need to know is the size of the memory. In plain English, the Dragon has approximately 32 thousand units of Random Access Memory. (32K RAM for those who prefer to be blinded by science.) This means that the Dragon's memory is at least twice as powerful as its competitors'.

With a memory this powerful, the amount of information the Dragon can store is literally vast. But the Dragon doesn't just make it easy to store information. It makes it easy to use, too.

USER-FRIENDLY?

You may have heard of the term 'user-friendly.' Reverting to plain English once more, this means simply that the computer will go out of its way to understand you, rather than vice-versa.

The Dragon 32 is so user-friendly, it practically licks your hand.

You tap (literally) its vast resources through a beautifully-designed keyboard that's as easy to use as a typewriter.

On this keyboard, you type in a language which is surprisingly close to the English you talk every day. The Dragon 32 will receive your order. Understand it. Send it to the appropriate section of its massive brain. And then display the appropriate information on your screen. All before you can say 'gobbledy-gook'.





*TV not included in price.

SPECIFICATIONS
6809E MICROPROCESSOR. Pet, Apple, Atari 400, BBC Micro, and VIC 20 still have the less powerful 6502.
32K RAM (as standard). At least twice the power of similarly priced machines. Expandable to 64K RAM.
EXTENDED MICROSOFT COLOUR BASIC (as standard). Featuring: ADVANCED GRAPHICS (set, line, circle, paint, print, draw, rotate and print using). ADVANCED SOUND 5 octaves, 255 tones. AUTOMATIC CASSETTE RECORDER CONTROL. FULL EDITING with INSERT and DELETE.
9 COLOUR, 5 RESOLUTION DISPLAY.
USE WITH ANY U.H.F. TV and/or separate P.A.L. monitor.
PROFESSIONAL QUALITY KEYBOARD. Typewriter feel. Guaranteed for 20 million depressions.
PRINTER (Centronics parallel).
JOYSTICK CONTROL PORTS.

PRODUCT / FEATURE	DRAGON 32	SINCLAIR SPECTRUM	ACORN ATOM	VIC 20	TI 99/4A	BBC MICRO 'A'
PRICE	£199	£125	£175	£190	£199	£300
STANDARD RAM SIZE	32K	16K	8K	5K	16K	16K
STANDARD AVAILABLE RAM FOR HIGH RESOLUTION GRAPHICS	26K	9K	N/A	N/A	14K	3K
EXTENDED MICROSOFT BASIC AS STANDARD	YES	NO	NO	NO	NO	NO
PROFESSIONAL-TYPE KEYBOARD	YES	NO	YES	YES	YES	YES

FIRE YOUR IMAGINATION.

Learning how to use the Dragon 32 won't cause you to experience any problems. Learning what you can use it for will cause you to experience something entirely different.

Delight. Surprise. Fascination. And challenge.

The Dragon offers a range of some of the most popular computer games in the world. From those celebrated space battles to mind-boggling adventures in seemingly unfathomable dungeons and caves.

As if by magic, a simple typed message will command the Dragon to create your own drawings. Then it will colour and paint them in 9 colours.

And it's clever enough to create virtually any image you want - circles and arcs as well as straight lines.

The Dragon will also play and compose music with you, with a range of 5 octaves. And it works with any UHF TV or PAL monitor.

LEARNING THROUGH PLAYING.

All of this makes the Dragon the ideal machine to build your children's interest in the world of computers as they become increasingly more vital. School-children already enjoy using computers.

The Dragon is the first computer specifically for the family - so by enjoying yourselves at home, you and your children can soon become expert enough to create your own programs.

BRILLIANTLY SIMPLE GUIDE.

The Dragon is living proof that you don't have to be an expert in computerspeak to be an expert in computers. It comes with the easiest-to-understand instruction manual ever written for a home computer.

Every step, every explanation, is made clear - even if you're a beginner. In minutes, it will show you how to write a simple program. Within hours, you'll be fascinated. And from then on, you'll continue to be astounded by the new world which the Dragon's power and versatility will open up to you.

See the new Dragon 32 in your High Street. At under £200, it's not just the first family computer. It also has all the features an expert could wish for.

Except perhaps the jargon.

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REVIEWS



Japan's new micros are here. What impact will the Japanese technological expertise have on Britain's home-computer scene? *Your Computer* takes the wraps off the new Sanyo trio on page 24.

SANYO PHC-10, 20 AND 25

MPF-II

With a display that an Apple could hardly be ashamed of and 64K of memory for just over £200, the Multitech MPF-II is not as ordinary as its plain looks and keyboard might imply. Tim Langdell puts the micro through its paces on page 28.



COLOUR GENIE

From the Far East comes the £199 Colour Genie — we rubbed the lamp and found a willing servant. Turn to page 34.

VIC-64

The Vic-64 takes up where the Vic-20 left off. On page 32 Simon Beesley finds that a versatile sound generator and colour sprites are just two of the extras which make it good value at £350.

Pretty boxes and elegant keyboards — Tim Langdell finds out what is inside Sanyo's shiny new micros.

BY THE END of last year the only personal computers on the market were the ZX-81, the Vic-20, and the Atom. Now, less than a year later you have the choice of a dozen machines from all over the world — many offering high-resolution colour and sound.

The Japanese have been noticeably absent from the under-£200 market until now. Sanyo's launch of three microcomputers is just the spearhead of a new Japanese invasion.

The Sanyos range from a strong Spectrum rival, to a cheap battery-powered pocket computer with an LCD display. All three micros have similar cases and full-size keyboards.

Sanyo's machines are wedge-shaped like typewriters and are 12in. wide by 6in. deep. The keyboards are a lesson in cheap but efficient design. Sanyo uses a similar rubber matting to the Spectrum underneath the keys but capped with hard plastic. A full-size space bar makes touch-typing possible although a keyboard bleep would have been useful.



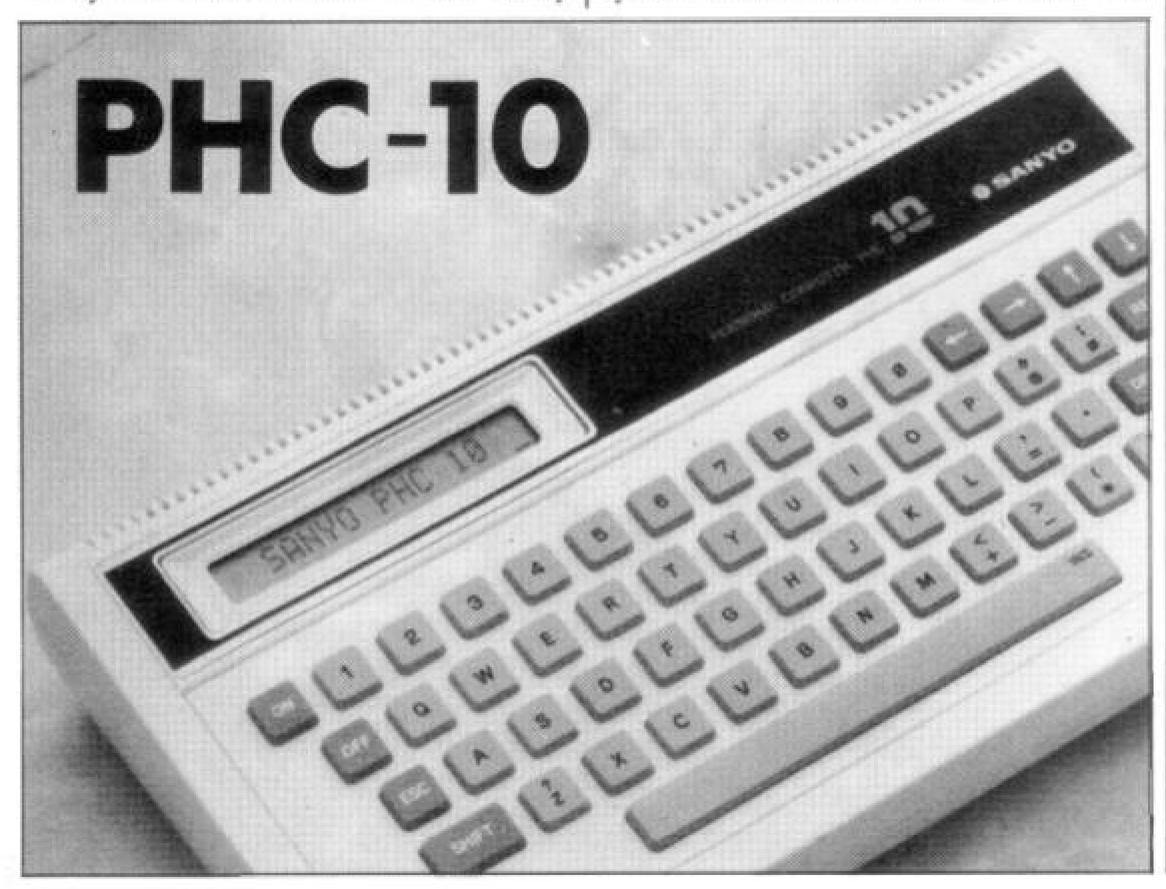
Top of the range

Sanyo's PHC-10 is a battery-powered £60 training computer with a single-line liquid-crystal display and no provision for television display. Next up the range is the PHC-20, a 4K RAM machine with no colour capability for about £100. But Sanyo's real hopes rest on the top of the range PHC-25 with high-resolution colour, user-defined keys and 16K RAM for about £150.

This nine-colour computer with high-resolution graphics has a full QWERTY keyboard, with keys for editing, Escape, CTRL, and graphics. The two Shift keys are double-width, as is the Return key.

The PHC-25 is based on a Z-80A CPU as used on the Spectrum, ZX-81, and early Tandy machines. The PHC-25 is nominally referred to as a 16K computer, but on requesting the free bytes in user RAM a return of about 14K is obtained. In contrast, the Spectrum 16K version really only has 9K, so the PHC-25 could still be considered good value on RAM, anyway.

The PHC-25's video RAM is separate in memory from user RAM, and the ROM containing the Basic interpreter and operating system resides in 24K. This leaves some 18K of free space in the machine's memory map.



Sanyo Basic is Z-80 colour Microsoft with a few changes for the specific machine. This is thus virtually the same language as used on the TRS-80 colour computer and Dragon 32. However, like the new Colour Genie, the Z-80-based versions of colour Microsoft seem somehow easier to use than the 6809 (Dragon) version, especially when it comes to defining colours.

For instance, CTon and CToff enable you to switch the cassette player on and off from within a program. Other commands include If-Then, Else, plus the usual Goto and Gosub. There are other especially interesting commands like On Goto and On Gosub.

The PHC-25 can not only draw lines using Line but, as with the Dragon, it can use an almost identical statement to construct a box from the line co-ordinates. It can even produce a filled-in box by the addition of one other letter in the statement. Its repertoire includes Paint, which means that full graphics capabilities are within the PHC-25's range.

Saving a screen

You can save a screen to cassette, you can directly access the Z-80A's ports with Inp and Out, you can load data files with Input$ and define functions. You can also Scroll just part of the screen using Console which can create text and graphics windows.

Colour on the PHC-25 is a little harder to use than on a Spectrum and the choices of colours vary with the level of resolution. There are four modes. The first is a text-only mode, the second is a nine-colour, low-resolu-

SANYO



tion mode 64 by 64, the third is a medium resolution mode 192 by 128 with nine colours, and the fourth is a 256 by 192 resolution mode. This has, it seems, only two of three possible colours, white, green and black.

Unlike the Dragon the same commands create the colours locally or globally in all modes, and the same commands put dots of colour on the screen. There is none of the fuss of clearing video pages, but then again the PHC-25 only offers up to two pages compared to four on the Dragon and these must be designated at switch-on. The colour from our test model was sharp, without dot-crawl.

The Sanyo PHC-25 has Escape and CTRL keys on the keyboard allowing you to either Pause, or to stop a program totally.

CTRL functions are also available: turning on and off a printer, changing video pages, and so forth. Using the graphics key lets you explore the massive internal character set of the PHC-25 — over 200 characters and graphics in ROM. In our machine there were 100 or so Japanese characters which will apparently be changed for extra graphics in the U.S./U.K. market.

An excellent feature is the four separate cursor keys and four user-defined keys which with Shift allow up to eight single-entry key-words or commands. These are set up upon switching on to produce useful key-words like Run and Return, List, Print, but can be redefined simply using Key.

The PHC-25 is clearly not designed for indefinite expansion. It comes with both a video monitor, a domestic TV outlet, a built-in Centronics port, a cassette socket, and a user port of undefined character. A sound-synthesiser box allows the PHC-25 to use its extensive Sound and Play commands to the full — it will have a three-channel synthesiser with envelope control. This extension box will also have joystick controls.

In conclusion, this machine is a real competitor to the Spectrum, having 5K more user RAM than the 16K Spectrum for about £25 more. It also has a more powerful Basic and its keyboard is certainly far superior.

The two lower-priced Sanyos enter a market already dominated by the ZX-81. The PHC-10 is a battery-operated microcomputer with an LCD display and no potential for expansion. It is purely a training device, somewhat outclassed by such machines as the ZX-81. It has the excellent full-size Sanyo keyboard, but a maximum RAM of only 4K. Its Basic is a version of Tiny Basic resident on the purpose-designed chip used as the processor.

It is easy to type programs into the PHC-10, but you can only see a maximum of 16 characters at a time. However, you can use the four cursor keys to scan through quite easily. Each key has auto-repeat.

The major draw-back is the 4K Tiny Basic. With less than 2K of user RAM, and a very limited range of commands, the PHC-10 would be restrictive even for a beginner.

(continued on page 27)



PHC-25

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EXPANSION MEMORY CARTRIDGES

Special plug-in cartridges are available to expand VIC's memory. 3K, 8K and 16K RAM packs plug directly into the computer.

A Memory Expansion Board is also available to develop VIC's capabilities to the maximum.

For full details of VIC 20, its peripherals and software, and a list of your local dealers, contact: The Commodore Information Centre, 675 Ajax Avenue, Slough, Berkshire, SL1 4BG. Tel: Slough 79292.





The best home computer in the world.

PHC-20

Actual size of Sanyo keyboard, above. Below back shot of PHC-25.

(continued from page 25)

Like the ZX-80, the PHC-10 can only handle integers. Thus dividing 5 by 3 will give an answer of 1. This is not a micro which will double as a home calculator.

Like the Sharp and Tandy handheld computers — which is the market it is aimed at — it will accept a program in the same way as a larger micro, but Running the program results in one-line-at-a-time display, unless the Return key is depressed. To get it to go through a program automatically you use Pause instead of Print in statements, which produces a display of each line at one-second intervals.

The PHC-10 also produces sound of sorts. A Beep command gives a note of a specified pitch for durations of a tenth of a second to 20 seconds.

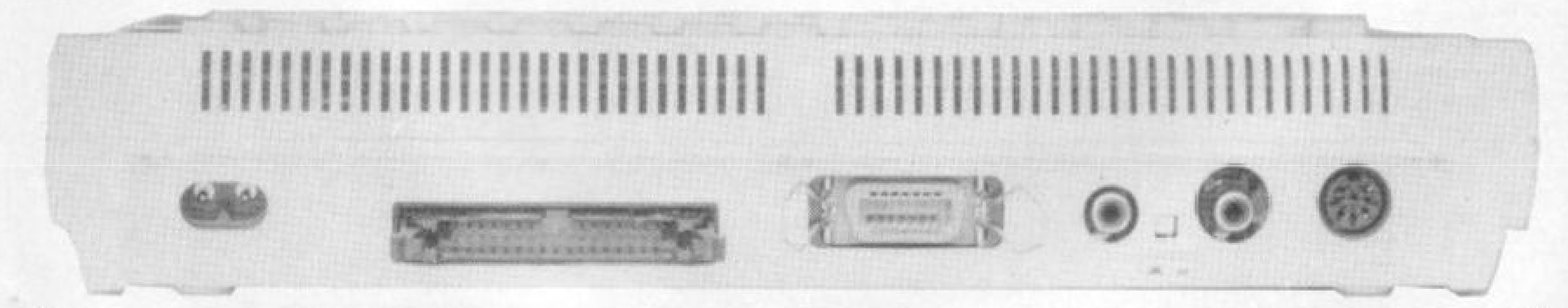
Good ergonomics

The PHC-20 shares the good ergonomics of its stablemates but may find it difficult to compete in Britain with the features home-grown micros are offering for £100. The PHC-20 is Z-80A based with 8K of ROM and 4K RAM of which 3K is available to the user. Little thought has been devoted to interfacing the PHC-20 to printers and other peripherals. Even connecting the machine to a television is not straightforward.

The Basic is early Microsoft, characterised by friendly if obscure syntax reports. Instead of the line numbers quoted by a Sinclair the PHC-20 will answer all errors with:

```
?? HOW
?? WHAT
?? SORRY
```

Loading from cassettes is quite easy but not trouble free. Although the PHC-20 is quite fast it is severely limited by an integer-only ROM.



CONCLUSIONS

- All the Sanyo machines are well packaged and have comfortable keyboards.
- At the bottom of the range the PHC-10 is little more than a training machine limited by integer Basic and the lack of a screen-display facility.
- The PHC-20 is again limited. Users can expect new machines to offer more than 3K user RAM, integer Basic, and black and white display for £100.
- Sanyo's PHC-25 offers a good keyboard, 14K of user RAM, high-resolution colour and user-defined keys for about £150.
- If Sanyo make the PHC range available in the High Street the 25 could be a winner. The British micro industry may be forced to do something about reliability and long delivery times. ■

REVIEW

MPF-II

Tim Langdell discovers whether the 64K MPF-II really is an Apple at far less than half the price.

TAIWANESE MULTITECH has pushed a new contender into the £200 colour-computer arena. Its MPF-II is a 64K 6502-based machine with six colours and a Basic which bears far more than just a passing resemblance to Applesoft. In fact the MPF-II is almost identical to a 64K Apple II — but without the expansion potential — and will run most Apple software.

About 32K of RAM is available to the user, and a further 16K or so is required for the video pages. It uses 16K of ROM, which again seems very similar to the Apple II. Indeed the few Calls we made to the ROM produced the same results as on our Apple. For instance, Call -932 cleared the screen, and Poking location 33 enabled us to set the line length to any given value.

Positive keyboard

The MPF-II's unattractive casing is flat and light-grey, about 7in. wide by 10in. deep, by about 1in. high — it is rather like an Apple in a Spectrum case. The keyboard is of the calculator type, although it has a more positive feel than many on the market. Multitech claims an inexpensive add-on typewriter-quality keyboard is also about to be released.

As soon as you begin to work with the MPF-II its similarity to the Apple becomes apparent. There are three modes: text, low- and high-resolution graphics. The text mode is black and white only, but six colours are available in either of the graphics modes. The lower-definition graphics mode has a resolution of 40 by 40, while the higher is 280 by 192. The MA command moves the screen memory to another location, and there is a choice of two high-resolution screens. The first leaves four text lines at the bottom of the screen: the second leaves just one line for, say, error reports.

The MPF-II has a full QWERTY keyboard with larger keys for Return, Space, Control and Shift. There is also a reset button, which is set precariously close to the 0 key, and four cursor keys. The keyboard is uncluttered, but hides many secrets.

Use of templates

The first of the two templates supplied with the machine reveals that the keys provide a full range of graphics functions, accessed by pressing CTRL B followed by any key. There are a total of 49 graphics ranging from a variety of line-drawing aids, through block graphics, to hearts, clubs, diamonds and spades.

The second template presents the surprise; pressing Shift and CTRL at the same time — they are conveniently adjacent — along with another key produces a full key-word on the screen. Thus you can type words in the normal manner, as well as use the Sinclair approach of single-key entry. Offering both is an excellent idea, and using templates instead of cluttering the keyboard is ingenious.

At the back of the MPF-II are sockets to attach either a domestic television or a video monitor. There are also Mic and Line sockets for your cassette recorder, and one for an AC plug. On the left-hand side is a printer interface, a plug-in ROM socket and a socket labelled RCB.

This socket is for the £10 Remote Control Box — or either a Chinese-character generator, an additional keyboard, or an £80 speech-synthesis and sound-generation box.

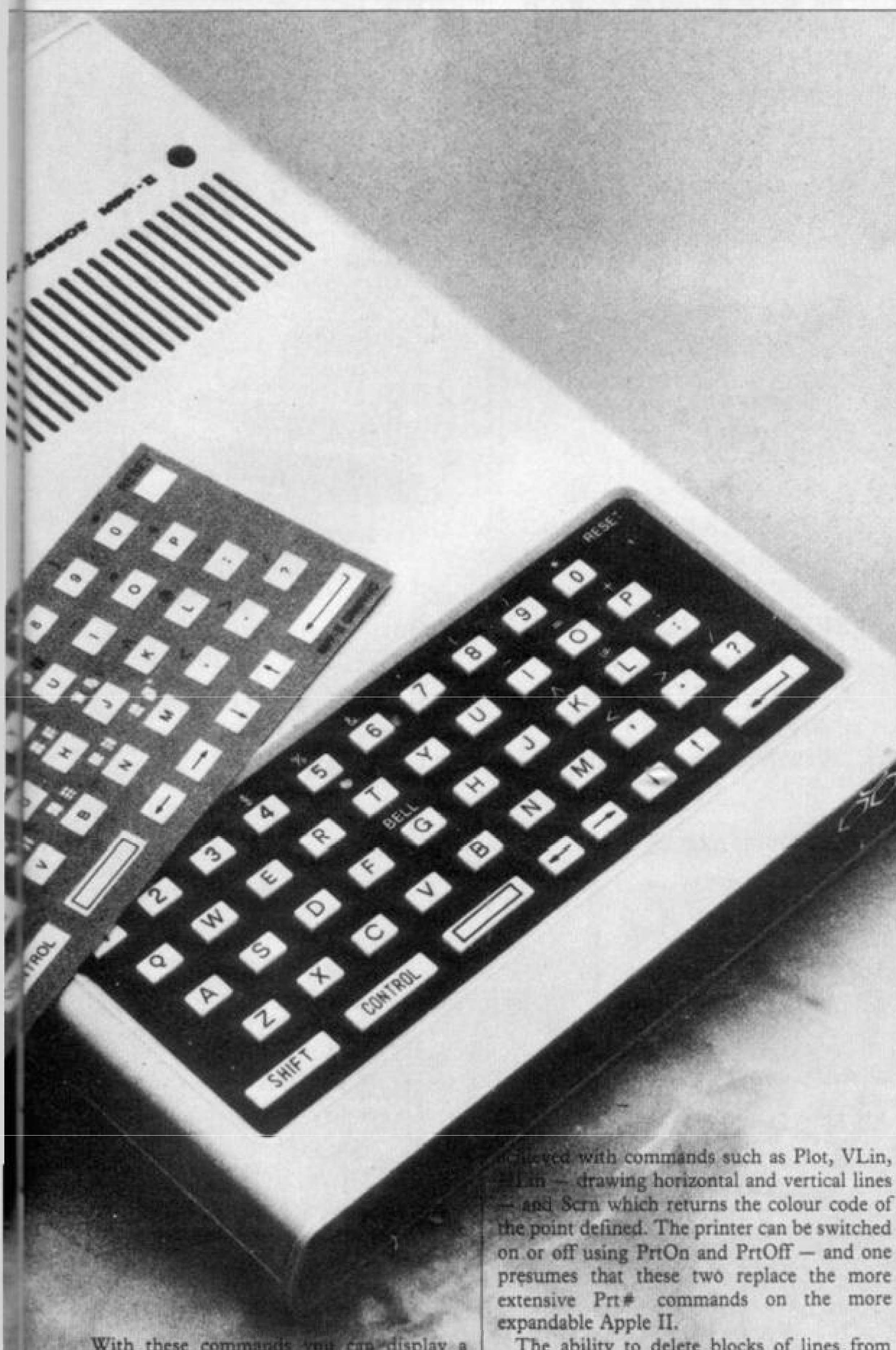
The MPF-II's Basic is excellent and, as stated, virtually identical to Applesoft. It may well represent the most powerful Basic available with a machine which costs less than £200. Table 1 gives a list of the key-words.

Capacity for graphics

Although the MPF-II can use only six colours, it can plot them in even the highest resolution. This is in contrast to all the other sub-£200 computers on the market which either limit the number of colours available in the high-resolution mode to two, or only allow definition of colour by character squares — for example, the Spectrum.

The MPF-II is thus capable of very good colour graphics in a limited range of colours. This is enhanced by an excellent facility — again, as offered on Apples — to be able to draw shape tables in memory using Draw, XDraw, Rot, Scale and SHLoad.





With these commands you can display a defined shape in memory on the screen, either as it was written into memory, or scaled up or down, or rotated through a given number of degrees, or drawn in the complement colour — XDraw. In addition it is possible to load such shapes on to cassette or disc and recall them again — astounding abilities for such an inexpensive computer.

The Basic contains all the standard data and variable handling key-words along with such unusual but very useful commands as OnErr Goto — when an error occurs a Goto is executed — On Goto, and On Gosub. The two graphics resolutions are set by either GR for low resolution or HGR for high.

Drawing lines and plotting points are easily achieved with commands such as Plot, VLin, HLin — drawing horizontal and vertical lines — and Scrn which returns the colour code of the point defined. The printer can be switched on or off using PrtOn and PrtOff — and one presumes that these two replace the more extensive Prt# commands on the more expandable Apple II.

The ability to delete blocks of lines from programs using Del is welcome, but the Basic sadly lacks a renumber routine. Screen editing, Multitech claims, is possible by moving the cursor to the line on screen with an error and retyping it. However this full screen-editing facility did not seem to work on the review version.

A rather interesting plus for those used to other inexpensive microcomputers is the fact that like the Apple the MPF-II has a built-in monitor which can be Called from Basic. Once Called, memory locations and register situations are displayed. With simple one-key commands you can dissasemble any area of the memory map into 6502 mnemonics.

Hex dumps are also possible, and there is also a facility for testing areas of RAM for certain bytes, moving bytes in blocks to other locations, and reading and writing machine code to tape or disc. Multitech has included two such systems, one for its own system, and one compatible with the Apple II.

Although sound is clearly possible with the MPF-II, directions on using it are not given in the manual. The useful Diagnostic Nurse supplied with the MPF-II runs a check on most aspects of the machine, including a display of its sound capabilities, which are essentially duration and pitch variations. Like the Apple, the MPF-II has a Trace facility to aid debugging. Unlike the Apple II the MPF-II is not expandable, but it will soon have a disc drive, the speech-synthesis and sound-generation board mentioned earlier and Pascal and Forth. A Chinese-language unit has already been produced which allows Chinese-speaking users to work in the Dragon symbol system. Excellent plug-in ROM games are available, and the Invaders and Bridge provided with our system were of excellent quality. A £110 printer will also appear soon, producing 150 lines a minute in a 40-character-per-line format.

CHR$, ASC, LEFT$, RIGHT$, MID$, POKE, PEEK, WAIT, CALL, USR, HIMEN, LOMEN, LIST, LISTx,y, DELx,y, REM, INPUT, INPUT" ", GET, DATA, READ, RESTORE, LET, DEF FN, GOTO, GOSUB, IF-THEN, FOR-TO-STEP, RETURN, POP, ON GOTO, ON GOSUB, ONERR GOTO, GR, COLOR, PLOT, HLIN, VLIN, SCRN, HGR, HCOLOR, HPLOT, HPLOT TO, HGR2, SIN, COS, TAN, ATN, INT, RND, SGN, ABS, SQR, EXP, LOG, PRTON, PRTOFF, HC, CONTROL, MA, MP, LOADT, SAVET, LOADA, SAVEA, LOADD, SAVED, DRAW AT, XDRAW AT, ROT, SCALE, SHLOAD, SPEED, TAB, SPC, POS, HOME, NEW, CLEAR, FRE(0), DIM, VAL, STR$, TRACE.

Table 1. Key-words.

CONCLUSIONS

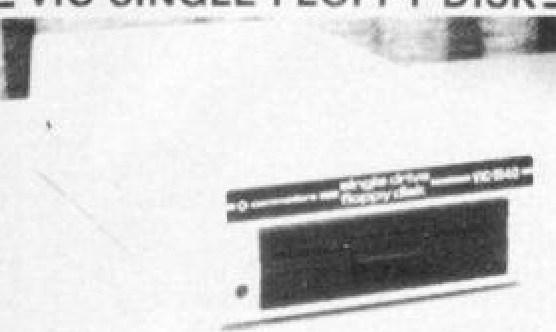
- The MPF-II offers excellent value at around £200.
- The fact that it is compatible with the Apple II means that an enormous amount of software is already available for it.
- It is the only £200 microcomputer with true high-resolution colour graphics, and offers a Basic which until now is to be found only on machines as expensive as the Apple II or a BBC Micro.
- The excellent idea of having the option of either single-key entry or normal entry of key-words should mean that the MPF-II satisfies everyone.
- It would make an excellent training machine, especially with its good, built-in monitor, but also a good home computer for the game player or a low-cost computer for the small businessman.
- Clearly, anyone who has been attracted by the Apple's facilities but not by its price will seriously consider this micro as an inexpensive alternative. ■

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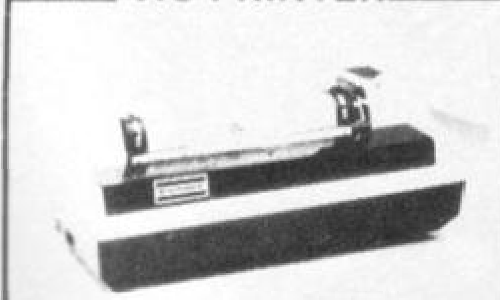
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The 64's strong selling point is its memory capacity, but — as Simon Beesley discovers — its other features all conspire to make it something of a force to be reckoned with.

COMMO
64

THE VIC-20'S STOCK has fallen slightly since it first went on sale last autumn. At the time it was welcomed as the only computer under £200 with colour and sound. Now it seems overshadowed by a number of competitors which offer more features at an equivalent price.

People tend to point to the Vic's limited memory capacity — only 3.5K — or its constricted screen layout of 22 columns by 23 rows, and belittle its strong characteristics as secondary features. But such secondary features as well-spaced and robust keys, or a good screen editor assume great importance for anyone who spends much time programming.

Improved screen size

The Commodore-64 remedies most of the Vic's shortcomings, while maintaining its virtues. The keyboard layout is the same and, apart from its beige colour, the casing has the same size and appearance. An extra games socket supplements the number of ports available on the Vic. These allow attachments to cassette, disc drive, program and games cartridges. A user port which will take a Z-80 cartridge to give the 64 access to CP/M software is also included. The VicModem, RS-232 and IEEE interface cartridges can also be plugged in.

Memory capacity and screen size are two areas in which the Commodore-64 improves on the Vic. 64K RAM is on board, of which 38K is available for Basic programs. The screen format gives 25 rows of 40 characters. Like the Vic, there is a choice of 16 colours and two character sets which include predefined graphic characters.

Commodore micros score highly for the ease with which one can change character sets, select graphic characters and alter the text or graphic colour. All this can be done through a combination of control and colour or graphic keys. Compare this with the laborious business of keying in a VDU command on the BBC Micro to change colour.

Easy to set up displays

Setting the background and border colours is equally convenient and just requires Poking a value into a single memory location. Multicolour mode on the Vic and the 64 enables you to use four colours within a single character space but is really only suitable for user-defined characters. Extended Colour Mode on the 64 is a new and more useful feature, which allows you to choose one of four colours for the background to a single character. The drawback is that only the first 64 characters can be used in this mode.

The 64 runs the same Basic as the Vic, itself more or less the same as Pet Basic. Programs should be transferable from other machines with 40-column displays if Peek and Poke addresses are changed.

The attractive feature of this Basic is the convenient way that cursor and colour control characters can be entered into character strings in a Print statement. They determine the screen position and also the colour of the text or graphics that follow after — making the task of setting up the display in a program considerably easier than it is in other versions of the language.

In these and other respects the Commodore incorporates almost all the specifications of the Vic-20. But it would have to be more than just an expanded Vic to justify a price of nearly £350 including VAT. Sprite graphics and a powerful sound generator are the features which supply the difference and lift it into the BBC Micro class.

The sound facility is at least as extensive as the BBC Micro's and, arguably, easier to use. Rather than being embedded in sound and envelope commands, sound control is obtained by Poking values into specific memory locations. The 22 sound-memory locations allow you to define notes in up to three voices with a range of eight octaves. Each voice can be set to one of four wave-forms — triangle, sawtooth, pulse or noise. The attack and decay and sustain/release parameters affect the way the volume of a note develops and fades.

Like the BBC's generator, the sound facility approaches that of a full sound synthesiser. A fairly close simulation of instruments such as the piano and harpsichord can be achieved as well as a variety of sound effects — the sound of jet engines, gunshots, wind, surf, snare drums, cymbals are some of the possibilities mentioned in the provisional manuals.

Sprites are user-definable shapes which can be moved around a 320 by 200 dot screen. The term was coined by Atari which offers a



similar feature on its microcomputers. A sprite object is defined on a grid 24 dots wide and 21 dots long; up to eight of them can be controlled at a time.

Fun with sprites

The video-display chip handles the writing and deleting of the shape on the screen. All the user needs to do to move a sprite is Poke new X and Y co-ordinates into the sprite register.

It is also possible to expand sprites, change their colour, and make them pass behind or in front of other objects on the screen. Two locations in the register can be read to detect potential collisions between sprites or other background objects. Clearly sprite graphics will be useful for games applications, particularly since they can be displayed on the ordinary screen with many other text and graphic characters, as well as in the high-resolution mode. It is not difficult, for example, to program a flock of sprites to pass behind the lines of a program listing — a rather bizarre sight.

The ability to read the entire character generator from ROM into RAM is a boon to the Vic user which makes up for some of the machine's deficiencies and provides a limited high-resolution facility. Not only does the 64 share this flexibililty, but it also supplies a separate high-resolution mode. You can open a screen with a resolultion of 320 by 200, which is bit-mapped to an 8K screen and leaves 24K RAM available to the user.

But it is a little misleading of Commodore to claim that the standard 64 offers high-resolution graphics since the Basic does not contain any line or point-plotting commands. Poking to screen memory would indeed light up a pixel; but locating a single dot on the screen is complicated by the fact that the bits in memory correspond to eight by eight blocks rather than successive rows of dots.

Promise for the future

A true high-resolution plotting facility on this machine will have to wait for the arrival of a language, which supplies commands like Plot, Circle, and Paint. Such a language is Simons Basic, which will furnish the resident Basic with refinements such as If-Then-Else, definable procedures and error-trapping found in more advanced Basics. This development will enable full use of the 64's ample memory capacity — 38K user RAM. One of the eight other possible memory configurations releases 52K for machine code or other languages. ■

CONCLUSIONS

- The addition of sprite graphics, high-resolution mode and a very effective sound generator to the Vic's specification make the 64 a very different, far more powerful and versatile machine.
- Like the Vic, the 64 will profit from a large range of cartridge-based software — as much of it for business applications as for games.
- It will be able to take advantage of much of the software and accessories for the Pet and the Vic, while cartridges for the Max — also known as the Vic-10 — are compatible with the 64.
- The 64 is let down by a rather limited Basic. The forthcoming Simons Basic should make good this failing, although it will up the price by at least £50.
- In respect of its other features the 64 is an excellent machine which can be highly recommended.

REVIEW

COLOUR



Made in Hong Kong it may be but Bill Bennett found that Eaca's Colour Genie was far from being just a toy.

THE COLOUR GENIE bears a passing resemblance to the Commodore Vic-20. It is a little larger, and a fair bit heavier. It has a two-tone brown plastic case, moulded in two halves, and a column of function keys down the right-hand side of the keyboard.

The main alphanumeric keyboard is of typewriter quality and is laid out in the time honoured QWERTY fashion, with the numerics in a row above the alphabet keys.

Keyboard features

The alphabet keys have pairs of graphics characters printed on their fronts. These are accessible via the keyboard and include lines, squiggles and crosses, as well as six dice-face characters and the symbols of the four playing-card suits.

The break keys, labelled RST, are at the two extremes of the numeric row and must be operated as a pair. The first eight numeric keys can be used to change the low-resolution colour by hitting Control followed by the desired colour key.

The Control key can access colours and graphic characters. The Mod SEL key on the bottom row can change the display into the high-resolution mode, when used in conjunction with the Control key.

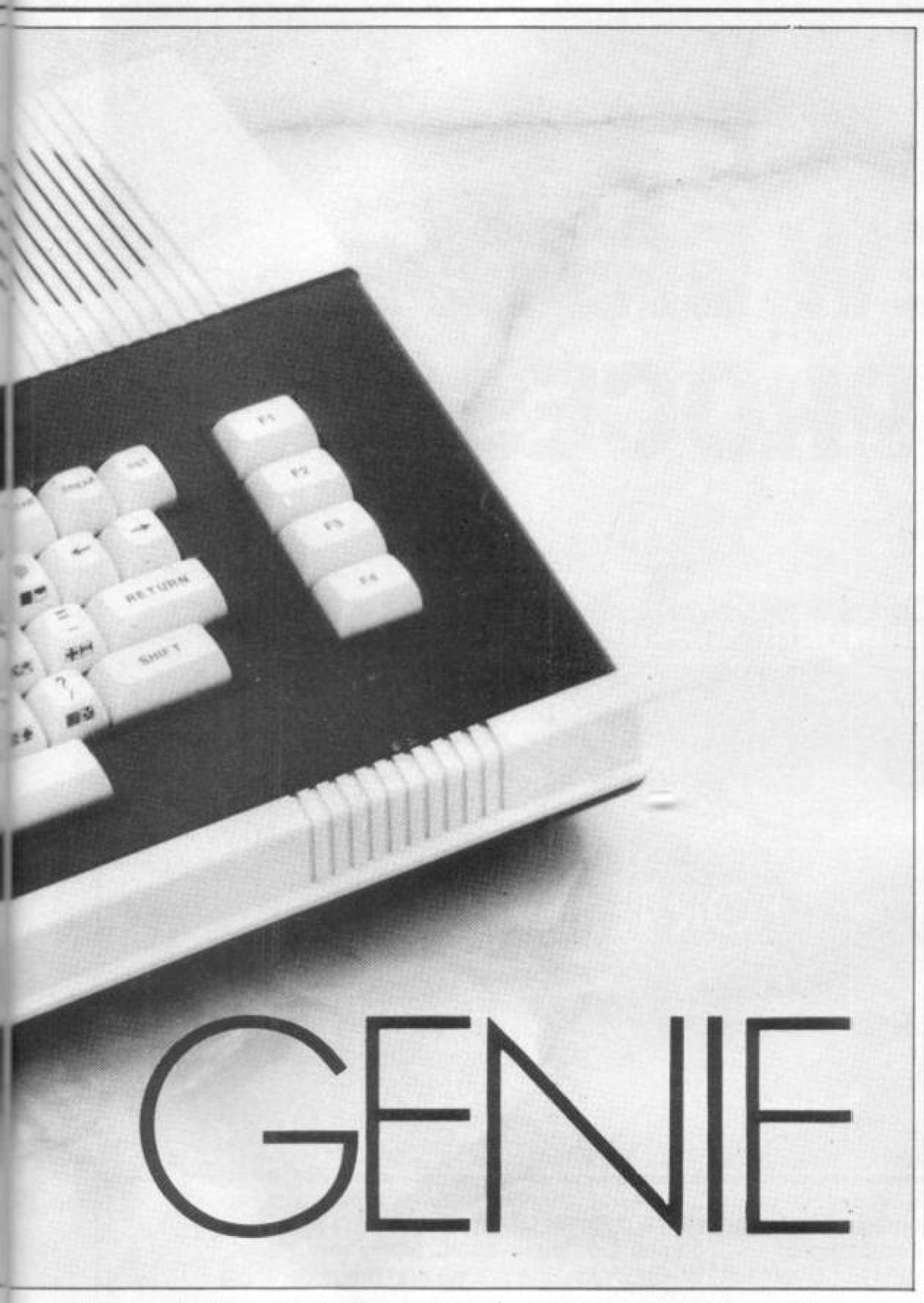
There are several ports around the side and rear of the Genie. The first port on the right-hand side is the parallel port. This is normally used to connect the Genie to a fast printer; however it could be used to interface with a floppy-disc unit. There is a DIN-plug socket for a light-pen, and another DIN-plug socket next to this for the serial port. It could not look much less like an RS-232 socket, and the way in which it works is not revealed by the pre-release manual.

The cassette input/output port is on the rear of the Genie, next to a cartridge port similar to the cartridge ports on the Dragon-32 and Vic-20. Whether or not there are any cartridges to fit it is another matter. Further along the back are two sockets: one audio and one a video-monitor socket.

The Genie costs £199.53 including VAT, thus placing itself in the most competitive sector of the home-computer market. Its real keyboard will attract the kind of user who would never buy a ZX Spectrum, and the machine is undoubtedly more powerful than the Vic-20. There are a number of other machines under £200 including the Dragon-32, the Atari and the Texas 99/4.

A competitive micro

The Atari, with its touch-sensitive keyboard, will appeal to a totally different type of user, and so cannot be considered as a rival. The Texas has only a small memory and so would appeal to yet a different kind of user, which



leaves us ironically with the Dragon. Ironic because the Dragon uses an almost identical version of Basic, and has some similar shortcomings in its colour.

The Dragon, moreover, has more memory and better graphics, but the Genie beats the Dragon hands-down as far as its sound generation facilities are concerned.

If you are a budding artist or animator the Dragon will be for you; however if you think that sounding like Depeche Mode or Kraftwerk is your idea of fun then it has to be the Genie.

The Genie's processor is the ubiquitous Z-80, running at a heady 2.2MHz. This makes it relatively fast, especially when compared to other Z-80-based micros that have colour. It would appear that the colour chips are the same as the Dragon and the Tandy Colour computer, but that is not definite.

The Colour Genie features an extended version of the Basic language. It is a very powerful implementation. Although there is only 16K of ROM, all the usual Basic commands are included as well as a number of extra commands which handle the graphics and sound capabilities of the Genie. There are also a number of extra editing commands — not really part of Basic — which make the programmer's life easier.

Language differences

However, there are inconsistencies contained within the Interpreter. For example; in the low-resolution mode, the command for defining the colour of a character to be printed is Colour, the English spelling. This is interesting because in the high-resolution mode, the command to set the colour at a point is Fcolor. On the whole, the Basic reminded me of Tandy Level II; hardly surprising, since the original Video Genie uses that dialect. The differences between the two languages are mainly in the extra graphics and sound commands. Tandy commands Set, Reset and Point are not included, since their function is made redundant by the high-resolution commands.

Although a user can enter any software written in the Tandy Basic, and run it, it is not possible to load Tandy cassettes. This is because signals are stored differently on the different machines.

The command to load a program from cassette is CLoad, or to load a specific program CLoad "program name". Twin stars then appear in the top right-hand corner of the screen. One of the stars remains constant, the other flashes. These flashes indicate that the computer has read in a particular character — most likely carriage return. If the twin star on the right does not flicker, then the cassette is not being read, and you know you have to start again.

The Edit facility is certainly useful, though difficult to use at first. The real advantage comes when debugging.

The Auto command means that the programmer does not have to keep entering line numbers. Programmers used to more expensive machines with Microsoft Basic will love the Genie.

Special commands

Commands available on the Genie which may be unfamiliar are: Char, which enables a special user-defined character set; Verify, which compares a program on tape with that in memory; System, which takes the user into the monitor program; Tron and Troff, a trace facility which prints out line numbers as lines are executed.

DefDBL defines as double-precision all variables beginning with a certain letter; similar commands define integer variables, single-precision, strings and arrays. Two useful features include Error which simulates an error and On Error Goto, which means the program does not necessarily crash if something is amiss. A number of unfamiliar functions, mainly dealing with double-precision variables, are also available.

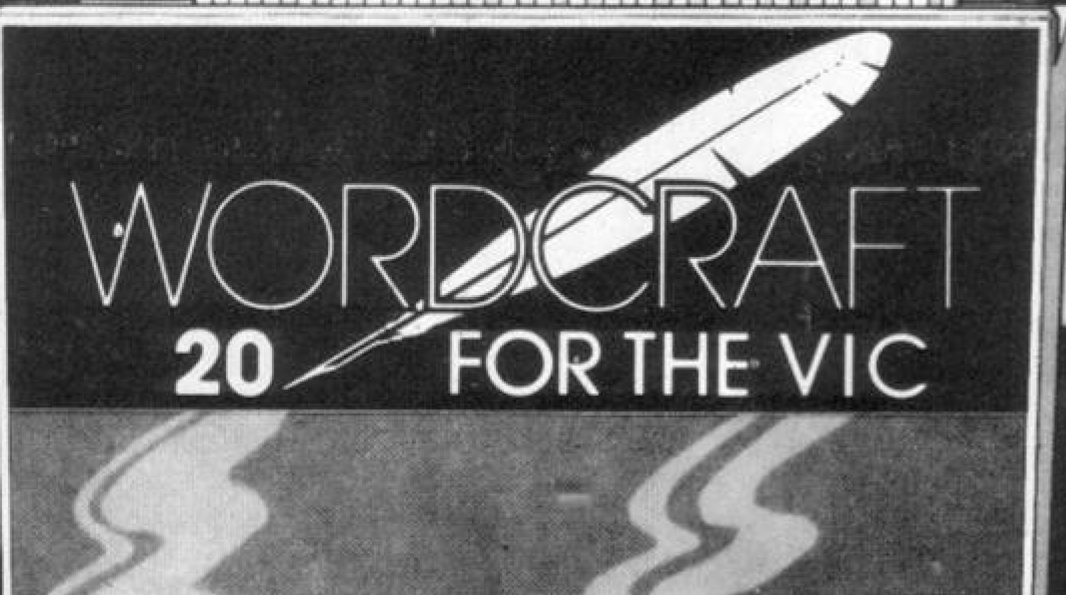
A special command is included to cope with a joystick. It returns a number giving a co-ordinate of its position. Maybe the most interesting command included in the Genie is Sound. I say maybe, because the pre-production documentation only hints that "the Sound command tells the music generator what combination of notes to play".

The music generated by the Genie is reasonably good; more to the point, the software makes it easy to use. The Play command is followed by four parameters, channel, octave, note and amplitude. My only criticism is that the user cannot specify the duration. ■

CONCLUSIONS

- The implementation of Basic and the musical facilities on the Colour Genie are as powerful as any to be found in this price range.
- The colour is a bit of a disappointment, but no worse than many competing machines. The resolution is not as high as it might be.
- A fine, but unremarkable machine.

A NEW ERA OF WORD PROCESSING



The introduction of Wordcraft 20 for the VIC brings the benefits and advantages of full scale word processing directly to the general public.
Until now only the business world could afford word processing systems but this amazing price breakthrough makes it available to everyone.
Wordcraft 20 comes on a cartridge ready to plug into the back of the VIC. Included in the cartridge is an extra 8K of RAM that is also available for use with other programs – so not only do you get a word processor but you also get a memory expansion thrown in. The system also comes with complete documentation catering both for the inexperienced user and for those already familiar with Wordcraft 80.
Just look at these features:

★ Full use of colour and sound.
★ Full compatibility with VIC 1515 printer, parallel printers or RS232C serial printers.
★ Full control over margins, document width, tab stops, decimal tabs, justified output, multiple copies. Complete control of the final output.
★ Automatic underlining and emboldening.
★ Full screen display with automatic paging.
★ Full storage and retrieval facilities from disk and tape.
★ Full compatibility with Wordcraft 80.
★ Name and address capabilities – including labels.
★ Full document merging facilities.

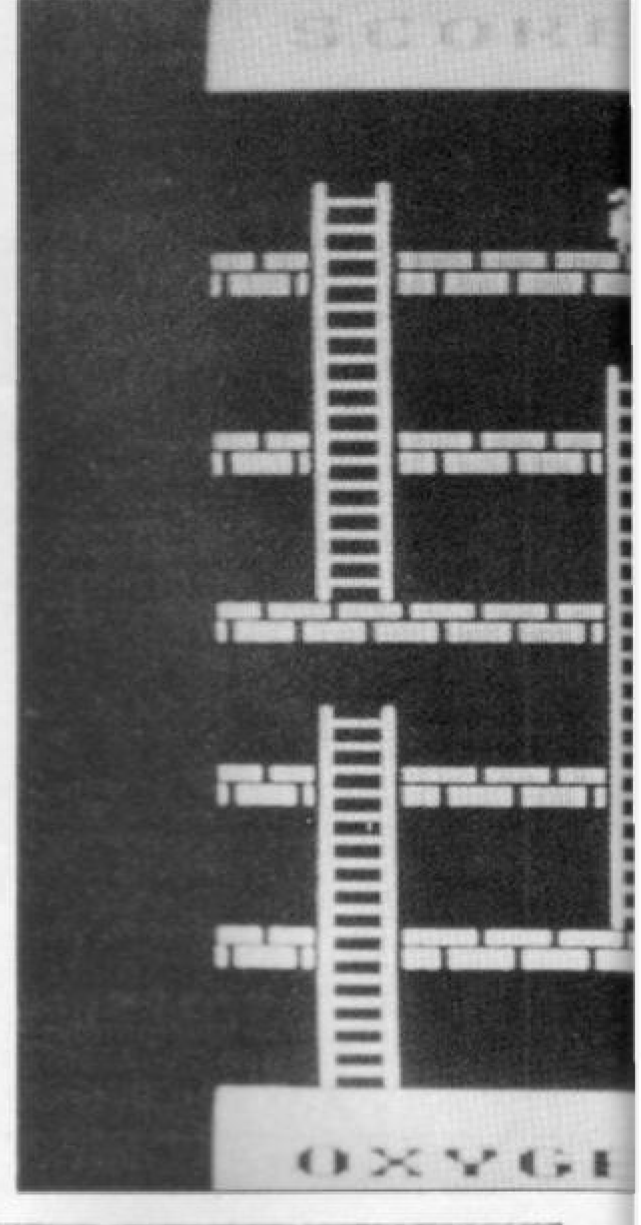
Wordcraft 20. The package that the VIC user has been waiting for. A word processor of proven quality at a low price.
For the first time ever, every home can have one.



Wordcraft 20: £125.00 inc. VAT and p&p. Available from all VIC dealers or direct from Audiogenic Ltd. PO Box 88, Reading, Berks. Tel: 0724 586334.

SURVEY BBC SOFTWARE

Spacemaze



Does the BBC need to do anything about the entertainment quality of its programs? Simon Beesley casts a critical eye over the first batch of would-be VDU stars now emerging from various software stables.

GIVEN THE BBC Microcomputer's extensive graphics and sound facilities it was reasonable to expect from this first batch of programs some high quality software — superior, at least, to what is available for other less well-endowed machines. As it is, only a handful of these programs fully exploit the BBC's potential.

Many of the programs under review were written in Basic and it is a mark of the speed of BBC's Basic interpreter that they are not noticeably slow. However, anyone using high-resolution graphics on the Model A has to fit their program into 6K, which is probably a little cramped if only Basic is used.

There were few problems loading from a cassette recorder specially adapted to the BBC's signal, but loading from a Ferguson recorder sometimes needed precise volume and tone adjustment. Programs are normally recorded at 1,200 baud but Beebug's cassettes contain a back-up copy at 300 baud. A & F will supply a 300 baud copy if problems are encountered.

A class of their own

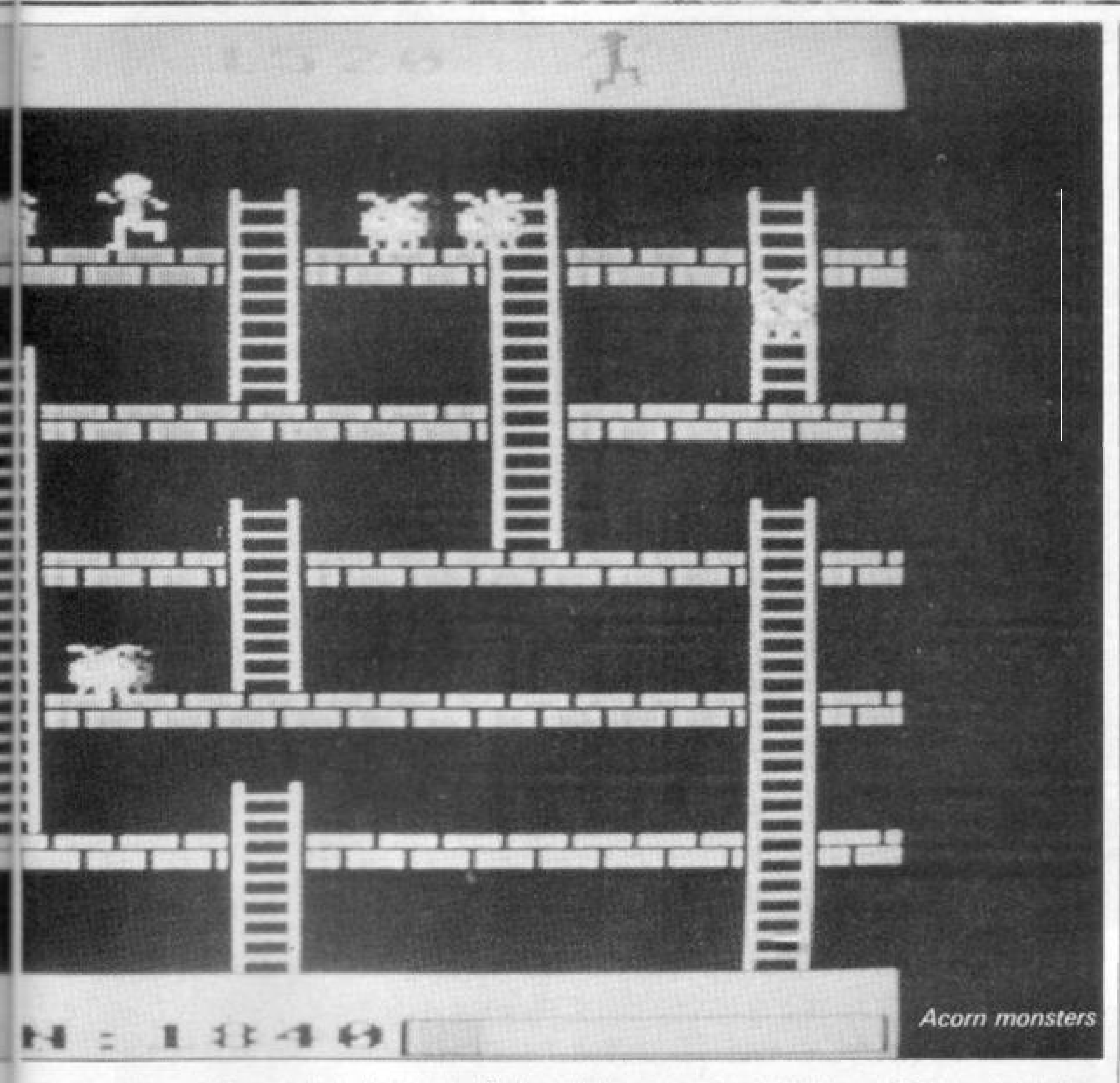
Acornsoft programs are almost in a class of their own. With their three games, Snapper, Defender and Monsters, they have faithfully reproduced every feature of the arcade originals. Unlike most other 32K programs, these need a 6522 VIA chip to be fitted, as well as a 16K memory expansion, before they can be run on a Model A.

Monsters requires the player to move his man up and down ladders and destroy the pursuing monsters — which look rather like mobile tomatoes — by digging holes and burying them. The speed of control response, sound effects and graphic detail are very impressive. Both Snapper, a Pac-Man-type game, and Defender achieve the same high standard of animation.

Defender involves piloting a spacecraft over a mountainous terrain and blasting successive waves of landers, mutants, baiters, pods, bombers and swarmers in an attempt to rescue humanoids. This is a demanding task since the action is very fast and is free from the jerkiness common to some computer games which try to achieve a number of different animated effects simultaneously.

Philosopher's Quest is an absorbing 32K text adventure game. If the reviewer's experience is typical, finding the correct route, avoiding traps, deciphering clues and returning with all the treasure could be a lengthy process. The program allows you to save a housekeeping file, which keeps a record of

Company	Game	Size	Price
Program Power	Timetrek	32K	£7.95
8/8A Regent Street	Spacemaze	32K	£3.95
Chapel Allerton	Munchyman	16K	£3.95
Leeds LS7 4PE	Chess	16K	£4.95
	Gomoku	16K	£2.95
	Disassembler	16K	£3.95
Acornsoft	Snapper	32K	£9.95
4A Market Hill	Monsters	32K	£9.95
Cambridge CB2 3NJ	Philosopher's Quest	32K	£9.95
	Defender	32K	£9.95
	Desk Diary	16K	£9.95
	Peeko-Computer	16K	£9.95
Beebug Software	Games 1	32K	£2.50
375 Wandsworth Road	Games 2	16K	£2.50
London SW8 4TE	Utilities 1	32K	£2.50
(only available to members)			
Bugbyte Software	Polaris	32K	£8
Freepost	Beebgammon	16K	£8
Liverpool L3 3AB	Golf	32K	£7
Personal Computers	Golf	32K	£8
20 Wellington Square	Monster Maze	32K	£6
Ayr KA7 1HB			
IJK Software	Cassette 1	16K	£5.95
55 Fitzroy Road	Startrek, Candyfloss		
Bispham	Cassette 2	16K	£3.95
Blackpool	Breakout	16K	£3.95
	Beebmunch	32K	£5.95
	Super Hangman	32K	£3.95
	3D Maze	32K	£3.95
	Mutant Invaders	16K	£5.95
	Invaders	16K	£4.95
A & F Software	Roadrunner	32K	£6
830 Hyde Road	Tower of Alos	32K	£6
Gorton	Lunar Lander	32K	£6
Manchester	Early Warning	32K	£6


Acorn monsters

your position, rather than start afresh each game. As a last resort you can send Acornsoft a post card for specific hints for "those who are totally baffled".

Loading a file of addresses from tape rather than flipping through an address book seems a little pointless. But if you want to maximise your involvement with your computer Acornsoft's Desk Diary might appeal. As well as an address file the cassette contains a day to day planner with a real-time alarm. Keep the program running long enough and it can tell you when it is time to pay your electricity bill.

Peeko-Computer simulates the workings of a simplified microprocessor. 80 single-byte memory locations are depicted with their contents. By using the cursor you can enter any one of 20 machine-code instructions drawn from the 6502 set.

Machine-code introduction

A program can then be run step by step while the changing contents of the memory locations and registers are displayed. Accompanied by an instruction booklet, this is a useful and unusual introduction to the principles of machine-code programming.

Two drawbacks attach to Acornsoft's products. At £9.95 they are fairly expensive, and they are not readily available. In the best Acorn tradition, buyers have had to wait more than two months for delivery. Otherwise these programs — all of them nicely packaged and well documented — can be highly recommended.

Program Power's Munchyman only costs £3.95 and runs in 16K but looks crude in comparison with Acornsoft Snapper: the keys do not auto-repeat and the graphics are poor. The same fault flaws their 16K chess program, where the pieces are not clearly distinct.

Eldorado Gold is a 32K adventure game set in cowboy and Indian country. Although the conception is not as grand as in Philosopher's Quest, the text is enlivened at times by a small illustration. If you enjoy adventure games you will find this quite engrossing. The reviewer was driven in frustration to break into the program and look at the list of command words. In common with other adventure games the player is given a few commands at the start but has to discover the rest.

Gomoku is a competent version of the board game in which the winner must place five pieces in a row in any direction. Spacemaze takes too long to display new positions in its 3D maze but includes sliding doors and a colourful monster. However, these and Program Power's other two programs, Disassembler and Timetrek, hardly stretch the BBC's facilities.

Too many companies are serving up the same old fare: Munchyman, Invaders, 3D Maze, Breakout, Golf, this Trek and that Trek — the list could well be expanded. Whatever machine they are implemented on, these games usually have the same format. IJK's versions of these standards are better than most but lack inspiration.

On Cassette Two are six short games — Hangman, Dice, Grand National, Kryptogram, Music and Beetle — for 16K at £3.95. Like a Christmas stocking the interest lies in the variety rather than the quality.

Invaders is a remarkably fast adaptation of Space Invaders, which fits into 16K using teletext graphics and the Y and arrow characters as missiles.

Other cassettes include programs for Breakout, Munchyman, Startrek, 3D Maze and Super Hangman. Although not very sophisticated, they are reasonably satisfying. Super Hangman draws a rather gruesome gallows and victim, while 3D Maze has the merit of rapid scene changes.

Along with Acornsoft, Computer Concepts' programs stand out. Snake is one of the few games that genuinely deserves the adjective "addictive".

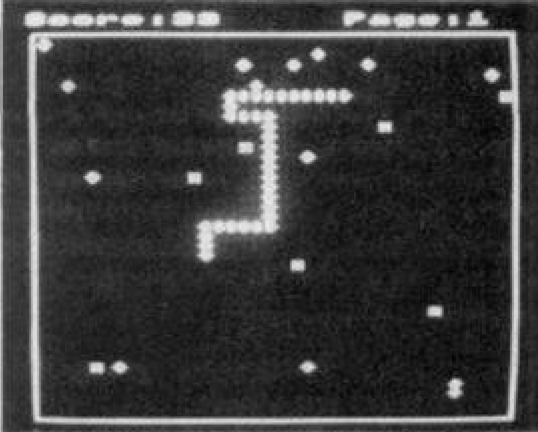
The object is to manoeuvre a snake around the screen, picking up segments which are added to its body. As the snake grows it moves faster and it becomes more difficult to avoid obstacles while the chance of colliding with the rear of the body increases.

Clearing the screen takes you on to a new layout, where the pace is even faster. This version is nicely done with several refinements such as the option of destroying obstacles with a laser, and appropriate sound effects.

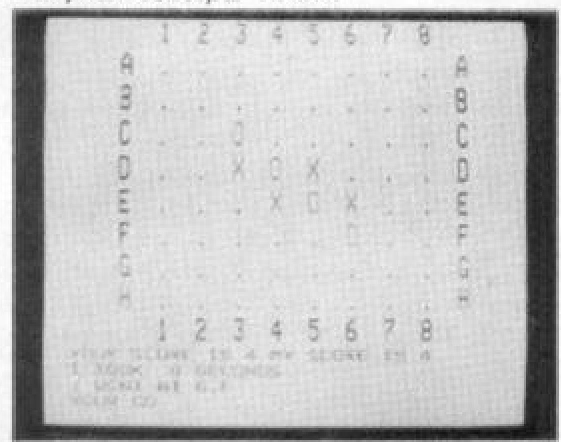
Sound Idea allows you to investigate the 18 parameters of the Sound and Envelope commands. New sounds can be heard by using the cursor keys to alter any parameter. The second part of the program lets the keys be

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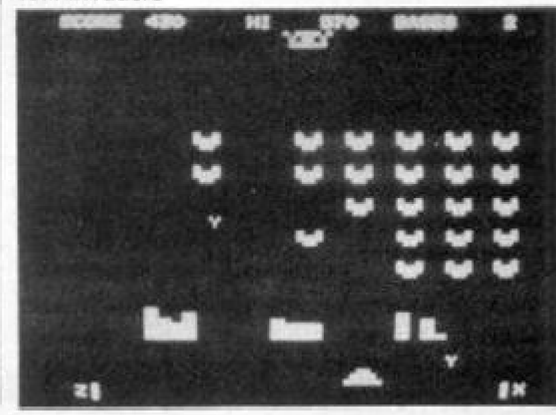
Computer Concepts' Snake

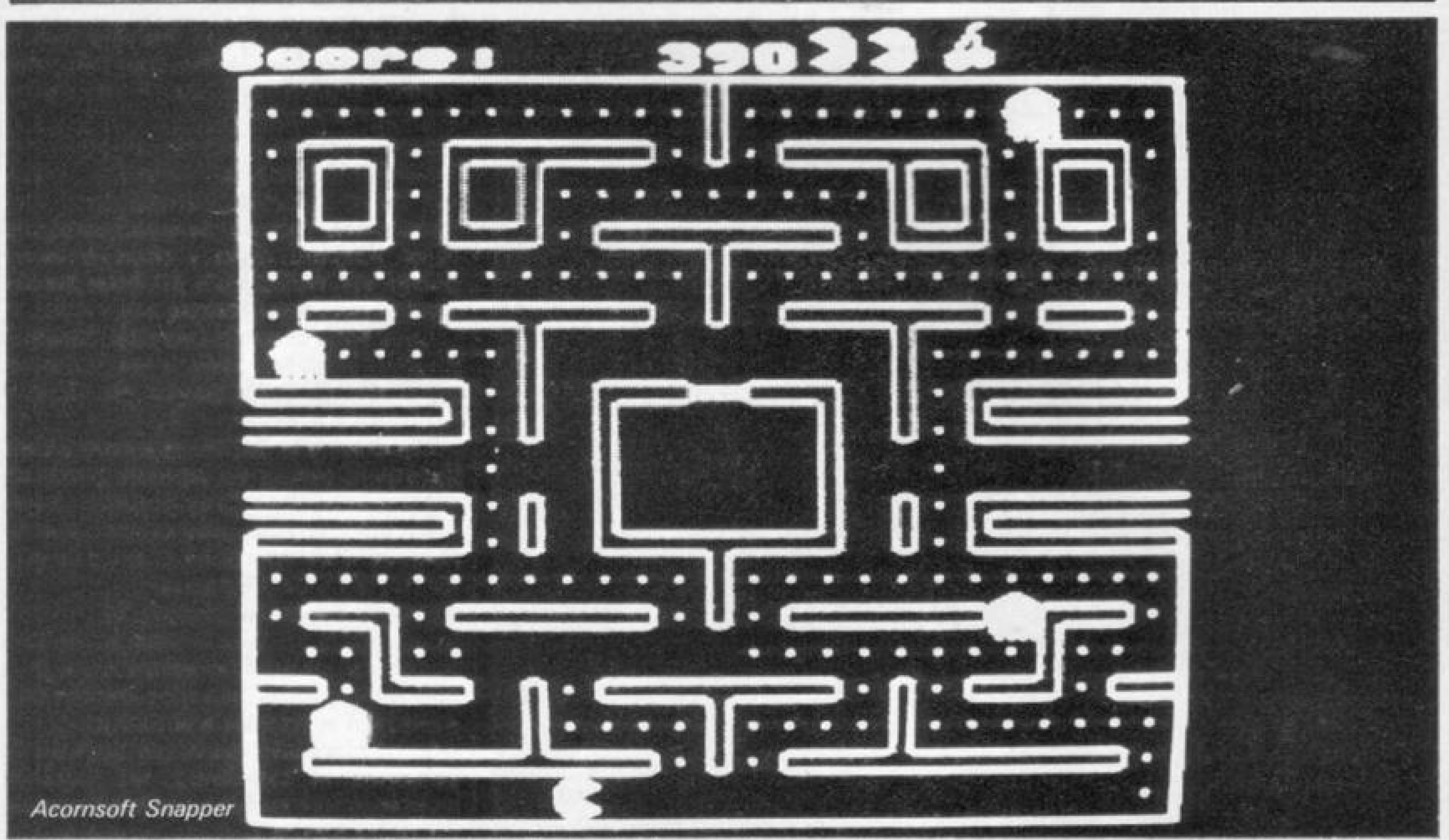


Computer Concepts' Reversi



IJK Invaders





Acornsoft Snapper

(continued from previous page)
played on as a musical keyboard using the pre-defined sound, or one of nine preset effects.

These are well-written programs, as are Reversi (also known as Othello) which plays a clearly set-out and hard-to-beat game, and Dissambler. A simulation of the Rubik Cube gives a 3D view of all sides and does all you might expect from it, but is probably only of interest to cubists. The other simulation of a one-armed bandit, Fruit Machine, could not be loaded from either cassette recorder.

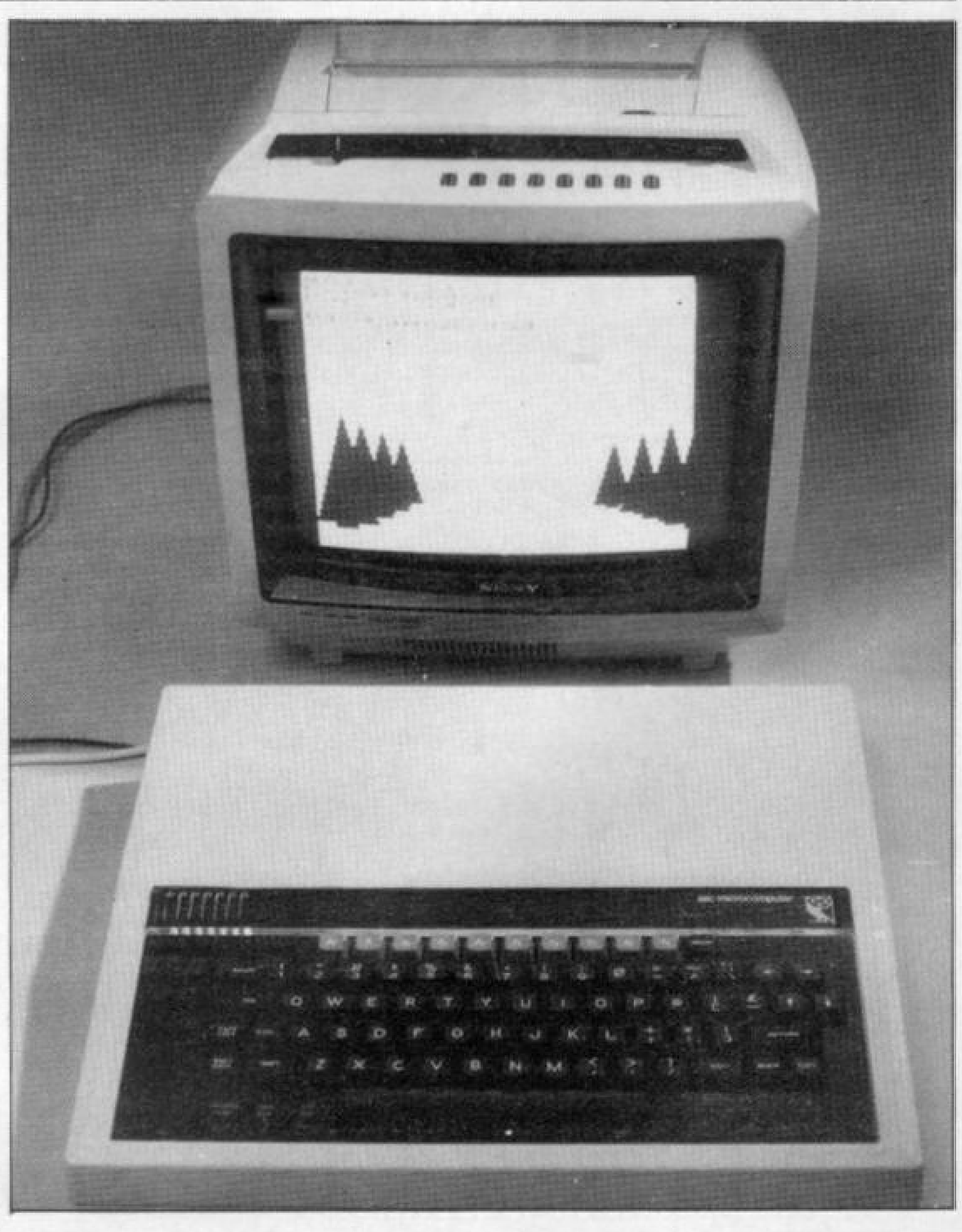
Software library

Beebug, the BBC's users' group, have launched their own software library available to members only. Their first four cassettes are good value at £2.50 each, particularly the utilities package, which contains a good dis-assembler, a character definer and a mini text-editor. The disassembler gives addresses in hex or decimal, 6502 mnemonics, machine code and ASCII characters if recognised.

Games 2 offers a moon lander game, which shows a vapour trail but no lander, and a nicely-displayed version of 3D noughts and crosses. Play on the Starfire program on Games 1 is confined to lining up your sights on enemy craft and firing; use of colour and sound, however, is excellent.

A & F's games are best described as adequate. Early Warning is a slow-moving version of Missile Command; Road Runner is a motorway version of Beebug's Polaris; in contrast, Lunar Lander is a slightly above-average treatment of this old favourite.

Their Tower of Alos makes more ambitious use of BBC's graphics. The player can move the £ character around two maps in a fairly complex game involving such items as dragons, castles, lizardmen and swordfights. Again, the game would have been greatly improved if these features had been shown in high-resolution graphics. ■



TECHNOLOG

HITC

Not many people could have made a personal computer into a star of stage, screen and television. But this is exactly what Douglas Adams did when he created *The Hitch-hiker's Guide to the Galaxy* — a hand-held electronic encyclo-aedia carrying a million pages of arcane information. His books chronicle the galactic wanderings of a bemused earthling. Meirion Jones asks Douglas Adams about life, the universe and everything.



WHEN IT COMES to technology, Douglas Adams is about as single-minded as his two-headed fictional anti-hero Zaphod Beeblebrox.

On the one hand — or perhaps head — much of his fun is made at the expense of people who are easily impressed by the next box of silicon tricks. He refers to them in *The Hitch-hiker's Guide to the Galaxy* as "The ape-descended life-forms that were so amazingly primitive that they still thought digital watches were a pretty neat idea". On the other hand he admits to being fascinated by every technical innovation.

When he says that "the information and computer boom is going to make a fundamental difference to everything" he sounds more like an Information Technology Year hand-out than the creator of Marvin the Paranoid Android. So what is Douglas Adams trying to tell us

'We're interested in technology for its own sake'

about progress in general and computers in particular — are they a Godsend or a menace?

"I don't think computers in general are a menace any more than hammers or saws are a menace — they are tools. A chainsaw in the hands of a lumberjack can be useful, but in the hands of someone who has just broken out of Broadmoor it's a different matter.

"I'm very interested in technology but I think we've reached the point of being interested in it for its own sake — we don't always compare the benefits of the technology with what we're putting up with to be able to use it. For instance, if you divide the number of miles the average American drives by the number of hours he either spends in or concerned with his car it comes out at roughly four miles an hour — and you can walk faster than that."

Adams concedes that cars and modern methods of transport have given people greater mobility but even that can have disadvantages: "The fact that we can travel much faster means that everywhere you go tends to be the same. Technology can be self-defeatng. It can also create new problems at the same time as it solves others. That perspective is behind a good deal of what I write.

"I was at Massachusetts Institute of Technology a year ago and they were showing me some research they were doing on video telephones. The main problem is the number of signals required for a television picture. You can either put a load of telephone calls down a wire or one call with a picture."

MIT had thought up a short cut using home computers: "They reckoned that everybody has a number of people they regularly speak to on the telephone. Therefore at your telephone you could have a small computer, storing video pictures of those people. When somebody rang you, a phonetic program would find the right picture and move the mouth in time with the words.

"They were very pleased with this compromise — after all, you could actually see a television picture of the person you were talking to. But if you look at that logically you'll see that this is not increasing communication — it is actually decreasing it.

"If you talk to somebody on the telephone your attention is concentrated on what they are saying. When you talk to somebody face to face or even on a television screen you get the message partly from their gestures and the expression on their face. But if you are seeing a picture which is not giving you any additional information the two impressions are totally contradictory.

"If someone rings up to say 'Oh God, I've just gone bankrupt' or 'My wife's run off' and you have this bright, smiling picture with the lips moving in an utterly grotesque way, it is not actually helping you to understand what the person is saying.

"The whole project is ludicrous and self-defeating but I couldn't get the researchers at MIT to understand that." Douglas Adams smiles as he glances around his flat which is a monument to the technical fetishism he has just been ridiculing. An Ansaphone, Entryphone and word processor poke out of a rubble of electronic executive toys.

Shamefacedly he admits "I sometimes get annoyed with myself — I'm a complete sucker for gadgets."

He waves a finger across the room over an abandoned psychiatrists couch, not to a chainsaw but to a yellowing Cambridge Footlights poster on the wall. "That's me in the turkey costume."

Douglas Adams started writing *The Hitch-hiker's Guide to the Galaxy* several unsuccessful years after he had first donned the turkey costume in the expectation of instant fame and fortune.

"I wanted to be a writer or performer in the same way the Monty Pythons are and therefore desperately wanted to go to Cambridge and get into the Footlights.

"While I was there I wrote, produced and performed in a number of reviews and when I left I rather expected that the world was going to beat a path to my door — which it absolutely refused to do.

"I started submitting bits and pieces for *Week Ending* on Radio 4 — but writing on the day to order was something I was hopelessly bad at so I was not making much of a living." At one stage some of Adams sketches were spotted by Graham Chapman of Monty Python. "We ended up writing together for nearly a year. I thought here I am, my big break — but it didn't work out. After directing a few shows on the Edinburgh fringe I realised I had done a lot of things without really getting anywhere.

"I was completely exhausted and utterly broke — couldn't pay the rent — could hardly pay the interest on my overdraft so I went home to Dorset and sat down to write *Hitch-hiker.*" The BBC accepted his script

'Some of my best friends are pebbles'

and Douglas Adams soon found himself in the radio comedy studio.

"Nobody else knew how *Hitch-hiker* was supposed to go. So I had to sit behind the producer's shoulder annoying him. I would say precisely what I thought should be done and he would ignore me very thoroughly. We sat in the subterranean studio at the bottom of Regent Street — hours and hours poring over one sound effect in this cavern of a studio. You'd go completely crazy — every now and then you would emerge into the daylight, stuff yourself with a McDonalds and then disappear into the murky depths again."

When Douglas Adams thought up *The Hitch-hiker's Guide to the Galaxy* his idea of an electronic hand-held book containing a million pages of information was sheer fantasy. Five years on advances in home-computer technology have made it just a matter of time before his science fiction becomes science fact. "I bought *Encyclopaedia Britannica* the other day — and then saw that Sony is bringing out a computer with a video-disc interface which means you could put the whole encyclopaedia on one disc. That's very close to the technology of *The Guide* itself.

"On the one hand I get very excited by it all; on the other it does make me rather nervous. We are heading to a totally different world." A worried glance out of the window reveals that we are still seated comfortably in Islington north London, rather than hurtling towards a small planet somewhere in the vicinity of Betelgeuse.

"I don't think I'm in a very strong position to predict the future — I'm not Arthur C Clarke saying we're going to have communications satellites or whatever. Saying I write science fiction is like saying the

GICAL



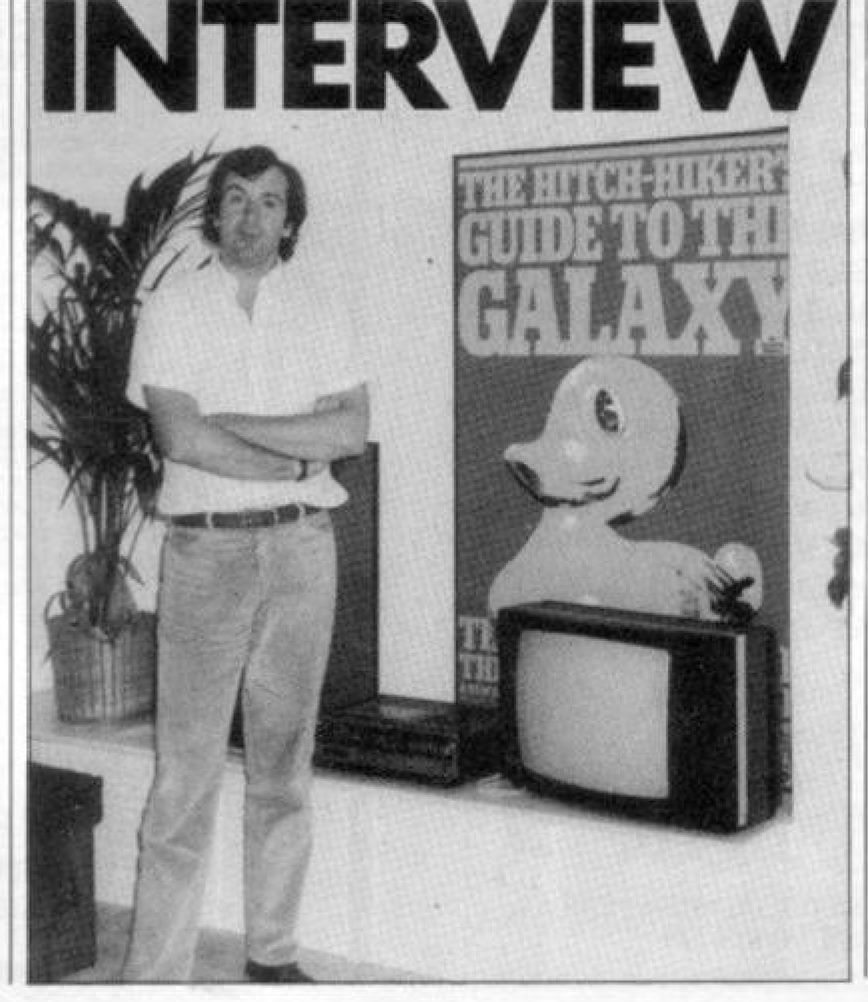
-HIKER

Pythons make historical movies — strictly speaking it's true but it's a rather limited view. I am writing about precisely here and now and putting it on an extreme epic cosmic scale to make fun of it. I'm not interested in the predictive nature of science fiction."

Douglas Adams does not set out to make fun of anything in particular when he is writing: "However, when you sit down to write something that is funny your attitude comes across.

"Usually what starts me writing is getting annoyed about something — not necessarily a huge issue like nuclear arms which in the end I find it rather difficult to make jokes about because it doesn't merely make me angry it actually gets me extremely frightened — but the petty niggles of life. Some stupid bureaucrat — if I've had anything to do with the telephone company that's usually a very fertile period. I get so angry I just want to sit down and write it out of my system.

"Sometimes you perceive attitudes in your writing that you'd never realised you had. Looking through the books for instance I realise I must be concerned about animals which I'd never realised I was.



Nonetheless Douglas Adams denies that he is or ever has been a secret vegetarian despite a scene in *The Restaurant at the End of the Universe* which was enough to put the most hardened Beefeater off his meat.

"I'd heard a vegetarian talking about the extreme position — which is worrying about plants and about how they feel. Where do you go on from there — somebody is going to come along and say 'some of my best friends are pebbles' and you're in trouble — what are you going to eat in the end? The assumption behind all this is that people, things, animals, plants don't want to be eaten — that's what's actually holding you up. Turn the whole problem on its head — breed a cow or whatever it is that says 'Hey, come and eat me — I like it'."

Sure enough when Adams' celestial hitch-hikers visited the restaurant they found themselves confronted by a cow that not only invited them to eat it but also obligingly shot itself: "What was interesting for me was not the vegetarian issue but the solution — a piece of lateral thinking."

Likewise although Douglas Adams latest book *Life, the Universe and Everything* — concerns Arthur Dent's life-and-death struggle, against the natives of a distant planet called Krikkit, to regain the Ashes which they have stolen from Lord's he maintains "I am not a great cricket fan. I just came across an article about the history of the Ashes — a cricket stump which was burnt in Melbourne in 1882. I happened to read it in a daydreamy mood and it went from there. There was not deep significance to it. At school I had a career which was a sort of microcosm of Ian Botham's. At one stage I'd been playing fairly well — I was made captain of the house junior 2nd XI. It was a great moment for

'I've been joking about computers for long enough'

me — and I turned in a succession of ducks — this is where I suggest the parallel with Ian Botham. So I was relieved of the captaincy — unfortunately, there the parallel broke down because I continued to do very badly. I was terrible at all kinds of sports. It was one of those schools where if you're not any good at football or rugby you're made to feel rather stupid about it.

From an early age Adams had been as prejudiced against computers as he had against organised sport. But his attitude changed when he bought a word processor to make his writing easier. "Although it's geared to a very simple task you begin to get glimpses into precisely what it is doing. The conceptual pictures you build up in your mind when you try and understand what it is doing are really fascinating.

"I suddenly thought 'Now I have to get a computer to find out all about that'. I've been making jokes about computers for long enough — it's about time I found out a bit more about them." Now he enthuses about the skills that the computer generation are acquiring.

"I met a director who was planning a verison of *Hitch-hiker* for American television. He explained that at first he thought he would have to strip the BBC version down and make the graphics simpler because he didn't think the audience would be able to cope. Then he visited a video arcade with his kid and realised that these kids playing Space Invaders, Puc-man and the like were acquiring a whole new range of skills, an ability to assimilate, process and react to any amount of information at any time.

"He thought: 'Which of the communications companies is in profit? — Warner Brothers — $2 billion profit. Why? — Atari. The kids aren't watching television — it's boring. They're down at the arcade or playing on a computer at home, which really stimulates and challenges their minds.' The director changed his mind about the TV production — the more information you pack in the more intriguing and seductive it's going to be."

Although *Hitch-hiker* was a very successful television series, Douglas Adams is not particularly keen to rework his last book for the BBC: "With *Hitch-hiker* the same stuff started on radio and then in a different form on record and then on TV — I was beginning to feel like a word processor rather than a writer.

"There were certain financial rewards in being able to rework the same material over and over again but you do get very depressed by it all. It becomes boring for me, boring for the audience — the only person it doesn't bore is my bank manager."

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'We're heading to a totally different world'

has been in the air for years but the trouble with *Hitch-hiker* is the immense amount of information which must be conveyed at any point. All the ideas which are explained thoroughly in the book are likely to hold up the telling of the story. I went to see *Tron* recently. The film was terrible, but the techniques for transferring computer graphics direct to film were quite fascinating.

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Two generations have mis-spent their youths to the whirr and click of the pinball machine. Now Stuart Nicholls offers the game for your unexpanded ZX-81 with this machine-code program.

Table 1.

16514	Random moves data +13, -13, +15, -15 decimal.
16522	Subroutine for selecting random change of direction but not reverse to give the correct bounce off the walls and bat. It uses "frames" as random-number generator.
16626	Initial random move for first ball, -13, is stored at address 40 40 H. This direction is upward so that it hits the top wall, and a random change of direction will be chosen.
16532	Places numbers 1 to 9 on alternate lines in random position. This uses seed-high frames low for the random number and sets seed for each number.
16668	Count next ball to be played and if 6 then Goto 16966.
16680	Print ball in random position at top of table and store position at address 403E.
16699	Print Press Shift. This uses the Print At subroutine in ROM CD F5 08* and print string subroutine CD 6B 0B*.
16714	Wait until shift key is pressed.
16721	Erase Press Shift.
16734	Delay to govern the speed of play.
16742	Jump over line 2 Rem data.
16745	Line 2 Rem data.
16751	Erase the ball.
16756	Print the ball number in play.
16767	Move the ball in direction stored at 40 40 H and check the new position.
a.	If table, then Goto 16802.
b.	If off bottom, then Goto 16668.
c.	If side top or bat, i.e., 80 H then Gosub 16522: then Goto a. If not b or c then must be number square so Goto 16879.
16802	Check keys 1 to 5 left. If they have not been pressed then Goto 16843.
16809	Roll the playing area and bat left then Goto 16879.
16843	Check keys 6 to 0 right, if they have not been pressed then Goto 16941.
16849	Roll the playing area and bat right.
16879	Check the ball position and, if not the number square, then Goto 16941.
16888	Print the number square in inverse video and increase the score by number value.
16923	Delay to hold the square in inverse video.
16931	Reprint the number square in normal video.
16938	Gosub 16522 to select random move from the number square.
16941	Print the ball in its new position.
16943	Goto 16734.
16946	Data for Press Shift and Game Over in inverse video.
16966	Print Game Over using ROM sub routines.
16981	Return to Basic.

PINBALL IS A game loosely based on the well-known arcade game. A ball starts at the top of the playing area in different positions and moves in a random way, bouncing off the sides and top of the table. If the ball lands on a number square, the score is increased by that number. The ball is then bounced off the square in a random direction.

The pinball table flippers have been replaced by a bat at the base line of the table, due to the memory restrictions of a 1K ZX-81. The numbered squares, 1 to 9, are printed in a variable position on the table so that each game is different. The method of playing the game is as follows.

The player has control over the whole of the playing area, as well as the bat. By pressing any of the keys 1 to 5, the whole table playing area except the ball will roll left — that is, numbers and bat will move left as long as the key is held down. The ball continues moving normally. Anything leaving the left-hand side of the screen reappears on the right-hand side. To make the table and bat roll right, press any key 6 to 0.

With these controls you have to try and land the ball on a number square as it bounces around the table.

If the ball misses all the numbers, then by skilful use of the bat it can be kept in play and hit back up the table. If a ball evades the bat it is lost, and a new ball will be given.

Five balls are given altogether, and the number of the ball in play is displayed on the top left of the screen area. To start each ball the Shift key must be pressed; an instruction to this effect is given with each new ball. Your score is shown at all times at the top right of the screen area.

The machine code can be loaded using:

```
10 LET X = 16514
20 LET A$ = ""
30 IF A$ = "" THEN INPUT A$
40 IF A$ = "S" THEN STOP
50 POKE X, 16 * CODE A$ + CODE A$ (2) -476
60 PRINT AT 11,7;X;"SPC"; A$(1 to 2)
70 LET X = X + 1
80 LET A$ =   A$ (3 to)
90 GO TO 30
RUN (IN FAST)
```

It requires two Rem statements each with 231 zeros. This is easily entered by typing 1 Rem (231 zeros) then edit line 1 and change it to line 2 Rem (231 zeros). When you have entered the machine code into the Rem statements in pairs or blocks i.e., 0D Newline — 00 Newline — F3 Newline or 0D00F3FF0F00 F1FF Newline and so on, enter S to end. Now type the only line of Basic necessary:

```
3 RAND USR 16565
```

and delete lines 10 to 90 as these are no longer required. I have given, in the listing, the addresses for the start of each routine, and those routines are shown in table 1.

The ROM subroutine for Print At requires the parameters column and line to be held in the BC register before being called. For example, the Basic order

```
PRINT AT 5, 3;
```

is rendered in machine code as

```
01 03 05 LD BC 0503
CD F5 08 CALL "PRINT AT"
```

The subroutine for Print String requires the start address of the string data to be held in the DE register and the number of characters in



PINBALL

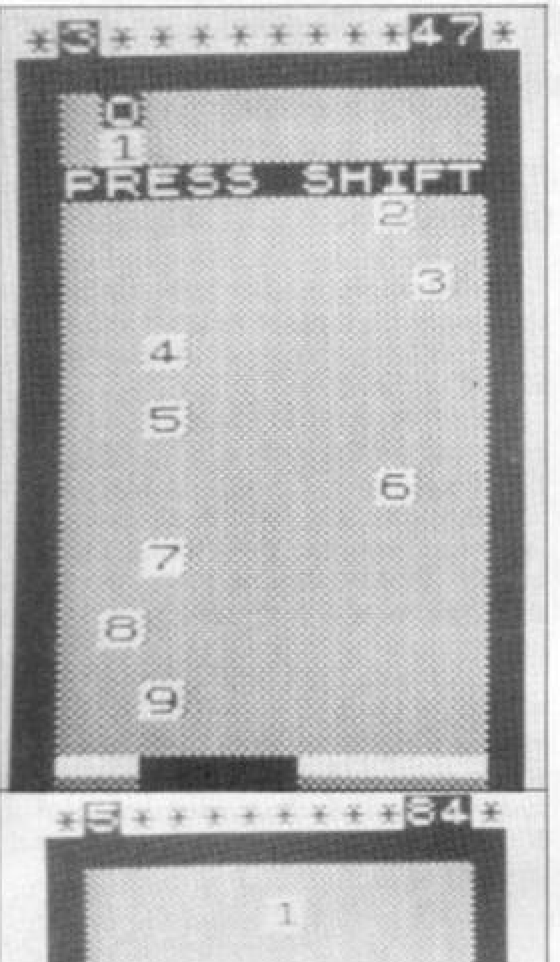
the string to be held in the BC register.

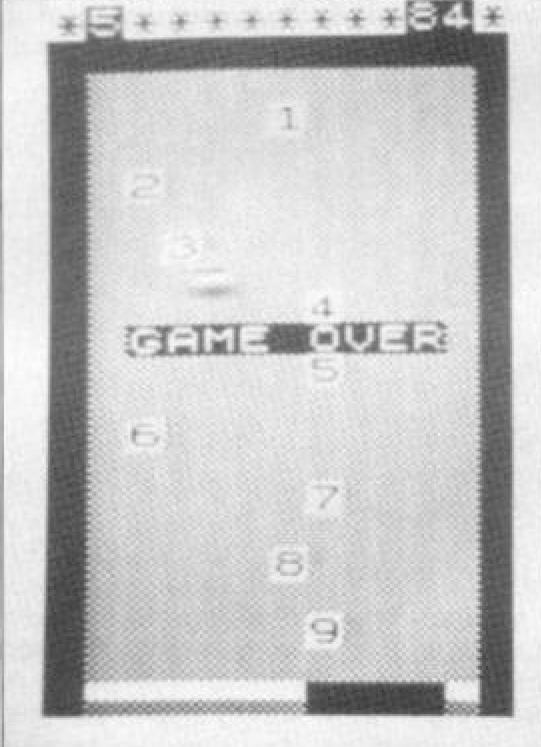
So in the print Game Over routine which begins at 16966, the Print At subroutine is called to get Print At to Line 10 Column 2. The BC register is then loaded with nine decimals — nine letters and one space. The DE register is loaded with 16957 decimals, the start address of the data, and the ROM subroutine CD 6B 0B is then called.

The machine code and display just about fill the unexpanded ZX-81 but if you have the 16K RAM then RAMtop could be set at 3K — that is, the collapsed display file leaves 2K for Basic instructions and so on. Do not increase the display file size while the game is running as the left and right roll routines may be corrupted — a CLS command would be necessary before

```
RAND USR 16565
```







L WIZARDRY

```
16514  0D 00 F3 FF
       0F 00 F1 FF
16522  2A 3E 40
       ED 5B 40 40
       E5
       3A 34 40
       E6 06
       C6 82
       6F
       26 40
       4E
       23
       46
       79
       BB
       28 03
       83
       28 EC
       E1
       09
       7E
       FE 80
       28 0D
       ED 43 40 40
       22 3E 40
       C9
16565  06 0D
       3E 17
       D7
       10 FD
       3E 76
       D7
       06 0D
       3E 80
       D7
       10 FD
       3E 76
       D7
       21 13 00
       3E 80
       D7
       06 0B
       3E 88
       D7
       10 FD
       3E 80
       D7
       3E 76
       D7
       2B
       7C
       B5
       20 EB
       3E 80
       D7
       D7
       D7
       06 07
       3E 09
       D7
       10 FD
       3E 80
       D7
       D7
       D7
16626  21 F3 FF
       22 40 40
16632  06 03
       3E 1D
       F5
       2A 32 40
       ED 5B 33 40
       19
       22 32 40
       7D
       E6 07
       C6 03
       4F
       C5
       CD F5 08
       C1
       F1
       D7
       04
       04
       3C
       FE 26
       20 E0
16668  3A 42 40
       3C
       32 42 40
       FE 06
       CA 46 42
16680  3A 34 40
       E6 06
       C6 1F
       16 00
       5F
       2A 0C 40
       19
       22 3E 40
       36 B4
16699  01 01 04
       CD F5 08
       01 0B 00
       11 32 42
       CD 6B 0B
16714  3A 26 40
       3C
       3C
       20 F9
16721  01 01 04
       CD F5 08
       06 0B
       3E 88
       D7
       10 FD
16734  21 00 14
       2B
       7C
       B5
       20 FB
16742  00
       18 06
16745  76 00 02
       E9 00 EA
16751  2A 3E 40
       36 88
16756  3A 42 40
       C6 9C
       2A 0C 40
       23
       23
       77
16767  2A 3E 40
       ED 5B 40 40
       19
       22 3E 40
       7E
       FE 88
       28 13
       FE 09
       28 89
       FE 80
       20 58
       AF
       ED 52
       22 3E 40
       CD 8A 40
       18 E8
16802  3A 25 40
       FE F7
       20 22
16809  2A 0C 40
       11 2B 00
       19
       11 13 00
       23
       7E
       F5
       06 0A
       23
       7E
       2B
       77
       23
       10 F9
       F1
       77
       23
       23
       23
       1B
       7A
       B3
       20 EA
       18 24
16843  FE EF
       20 5E
16847  2A 0C 40
       11 32 01
       19
       11 13 00
       7E
       F5
       06 0A
       2B
       7E
       23
       77
       2B
       10 F9
       F1
       77
       2B
       2B
       2B
       2B
       1B
       7A
       B3
       20 EA
16879  2A 3E 40
       AF
       7E
       FE 88
       28 35
16888  F6 80
       77
       DE 9C
       47
       2A 0C 40
       11 0C 00
       19
       7E
       FE 17
       20 04
       36 9C
       18 F7
       3C
       FE A6
       20 05
       36 9C
       2B
       18 ED
       77
       10 E3
16923  21 00 09
       2B
       7C
       B5
       20 FB
16931  2A 3E 40
       7E
       C6 80
       77
16938  CD 8A 40
16941  36 B4
16943  C3 5E 41
16946  B5 B7 AA B8
       B8 80 B8 AD
       AE AB B9 AC
       A6 B2 AA 80
       B4 BB AA B7
16966  01 02 0A
       CD F5 08
       01 09 00
       11 3D 42
       CD 6B 0B
16981  C9
```

■

LANGUAGES ATOM

Forth leads other languages for versatility and speed. John Robinson reviews Forth on the Atom.

FORTH IS A stack-based programming language with a lot of novel features. It is constructed from building blocks called "words". Stack and word are two terms which have special significance in Forth literature, so let me define them.

A stack is a pile of pieces of data. You may only store data on the pile by putting it on the top. If you want to take data from the pile, you can only take the topmost item.

Stack is just a smart word for this sort of pile — other names that you might see used are push-down stack or last-in, first-out queue. Forth expects you to use the stack to store your variables, in contrast to Basic which expects you to use variables or arrays.

```
(                                            )
( print formatted multiplication tables      )
( up to the limit of number found on stack )
(                                            )

: TABLE
( add one to limit and then                 )
( make two extra copies of limit on         )
( stack for later use as loop index         )
1 + DUP DUP
( print a newline character                 )
CR
( print four spaces                         )
4 SPACES
( print line of multipliers, each one       )
( right adjusted in a field four            )
( character position wide                   )
1 DO
   I 4 .R
LOOP CR
( now print multiplicand and product        )
( each multiplicand is on a new line        )
1 DO
   I 4 .R
   ( create new copy of loop index          )
   ( for inner loop                         )
   DUP
   ( loop to print product                  )
   1 DO
      I J * 4 .R
   LOOP CR
LOOP
( remove final loop index from stack        )
DROP
CR CR :
```

Figure 1.

The nearest Basic equivalent to a Forth word is a subroutine. Both are lists of instructions which do things like move data, print on the screen, control the flow through the program or perform arithmetic. Both subroutines and words are written only once but called many times.

Atom Forth comes with nearly 200 words already defined. To write a program you just build your own words up from the predefined words or words that you have written yourself. Do not be put off by thinking that you have to learn all 200 — you only need to understand about 20 words to start writing useful programs.

Forth treats words that you have written in the same way as supplied words. So, when you write your own words as part of a program you are also extending the language.

The words supplied include structured programming goodies such as If . . . Then . . . Else, Do . . . Loop, Begin . . . Until and Begin . . . While. One final point: Forth is compiled, rather than interpreted so it will run very quickly — much faster than Basic — but it still allows you to write programs interactively, so that testing and changing programs is fast.

To start to use Forth on your Atom — which must, by the way, have the full 12K of RAM — you need the Acornsoft cassette and the accompanying *Forth Theory and Practice* manual. The cassette has an index at the start of the tape that helps you to set the playback level correctly.

After the index come the Forth system, a tape interface, a screen editor, a set of graphics commands and finally a demonstration program. The manual itself, *Forth Theory and Practice,* is a nicely-produced volume which serves as both a good introduction to the language and as a reference manual. By the end, it has reached the stage of telling you how to extend the language with your own chosen facilities.

Unfortunately, there is no index, and one or two mistakes have crept into the text to confuse the innocent reader.

Using Forth

Once you have loaded Forth you will see a message on your screen announcing that you are now in Atom Forth, followed by the Forth prompt OK. This is where you'll need to refer to the manual because, when the Atom is running Forth, most of what you have learnt about the Atom's operating system, its Basic and its assembler is of little use. In fact, the Atom is like a brand-new micro when it is running Forth.

At this stage, the obvious move seemed to be to add some new words and so explore some of the facilities in Forth in comparison with Atom Basic. Here are two simple Forth programs which are written as just one word. Square merely squares a number that you give it.

```
: SQUARED
DUP * . ;
```

The colon tells Forth that a new word is to be defined. In this case, the word is called "squared". After the name comes a list of Forth words that define this new word. The first word used is Dup which duplicates the top item on Forth's stack. Our new word, "squared", expects to find a number on the stack — you would put a number there by typing it just before the word that needs it.

The second word is an asterisk — this counts as a word to Forth. It takes the two topmost items off the stack, multiplies them and places the result back on the stack. Thus, two items are replaced by one. The last word is the dot or full-stop which is the Forth word to print the topmost number on the stack. The semicolon at the end of our new word tells Forth that we have finished our definition. As soon as we press the return key, Forth will compile the new word, "squared", and we may test it. As you may have guessed, all this word does is to print the square of the number that we give it, so if we type:

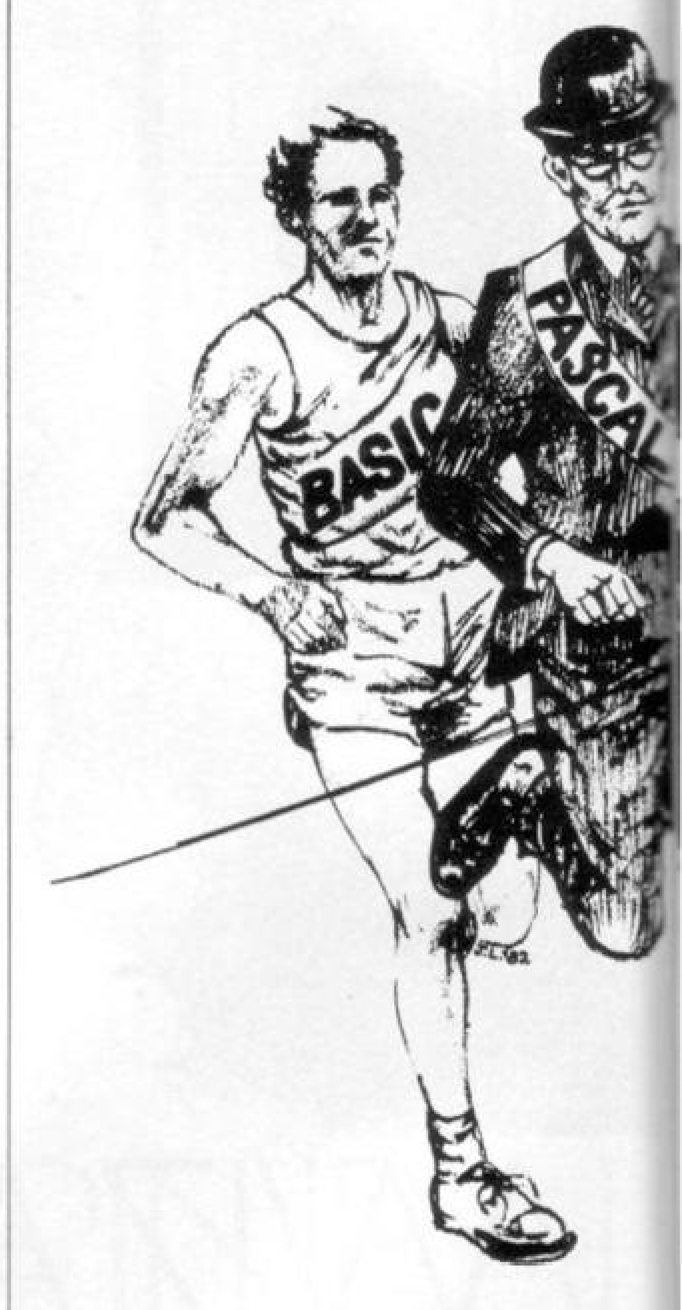
```
3 SQUARED
```

Forth will respond with

```
9 OK
```

Table is a word that prints out multiplication tables up to a number that you specify. So, 3 Table prints the one, two and three times tables formatted on the screen.

Note that Forth treats everything between brackets as a comment. Figure 1 shows how Forth words may be used to format the screen.



FORTH



The example is perhaps over-simple for a real program and shows only what Forth looks like. Some of the features that set Forth above Atom Basic and free the programmer from unproductive drudgery are shown in figure 2.

As I mentioned earlier, the Acornsoft Forth package also contains a screen editor and support for the Atom's high-resolution graphics.

The screen editor appears unconventional at first, mainly because the editor commands are supplied as a new set of Forth words and because it operates, as the name implies, on "screens".

This does not mean your TV screen, but a block of eight lines of Forth program — the chunk that the editor will display and that can be moved to and from tape.

A short time spent getting to know the editor is worthwhile, because of the powerful commands which put most micro editors to shame. The editor works both on complete lines of Forth and on strings of characters within lines.

I have listed some of the more interesting editor commands in figure 3. There is no need for anyone to produce a Forth toolkit like the Basic toolkits to enable the use of commands to find or delete a character string. All this and more is included in the system

Formatted numeric output
IF . . . THEN . . . ELSE
Use of any base up to 36
Progress displayed during tape load
Equivalent of INKEY$ — not in Atom Basic
Variable names up to 31 characters long
Memory manipulation commands
Signed or unsigned numbers; no floating point
No memory penalty for writing plentiful comments
Both constants and variables allowed
Compatible with Forth on other machines

Figure 2. Forth features not in Atom Basic.

supplied. Indeed, since the editor commands are Forth words, it is possible to add your own commands to the editor — how many of you have an editor that lets you do that?

I was slightly confused to find the tape interface listed as one of the programs on the Forth tape. All became clear when the manual explained that Forth itself contained just enough of the tape interface to load the rest. The other parts allow you to save programs back on to tape and to list screens of Forth from a tape copy. The tape interface does not make it any easier to use tape for storing data as well as programs — this is one of the few things that is definitely easier in Basic. However, one pleasant surprise is that the tape interface gives you some idea of whether it is loading properly by displaying the last screen number read.

There is little to say about the graphics words supplied since the facilities are similar to those in Basic. You may plot points, draw lines or move from point to point without plotting.

The two exceptions are that there are no words supplied to use colour graphics and that

P	put text on to a line
D	delete a line
I	insert a new line
T	type the screen again
M	move editing cursor forward
C	insert text after editing cursor
F	find a character string and move cursor
N	repeat previous find command
TOP	move cursor to the top of the screen

Figure 3. Editor commands.

the highest resolution graphics mode (256 points by 192) is unavailable because Forth uses part of the Atom's graphics memory. The whole area of graphics is probably the most effective area for using Forth facilities to add new words.

Some of the newer machines have graphics commands that do more than just draw straight lines — an example is the BBC Micro's inclusion of a Basic statement which will draw triangles. This is not a facility supplied in Forth but the manual does show the definition of a word that will do just that. Other possibilities would be for a Forth user to write words that display circles or even space-invader type graphics.

Adding new functions

Since the way to write Forth is to write new words and extend the language, it is encouraging that the manual has three good examples of adding new functions. These show how you can define character strings and one or two-dimensional arrays as new types of data and, incidentally, how you can decide whether or not to make Forth check whether you are accessing elements within the limits that you chose when you defined the array. A way of adding a form of case statement is also shown, together with methods of creating special graphics words.

Really, my only disappointment with Atom Forth is that I can no longer use the assembler sitting in the Atom's ROM. Some other Forths have a built-in assembler — it seems crude to have to hand-assemble or write down the machine code generated by the Atom assembler and include it in a Forth program by hand.

I have mentioned before that Forth is faster than Basic. To try to prove this, I wrote some very simple (and probably unrepresentative) programs in both languages that show the difference in speed. Each program loops 10,000 times so that timing is possible using a watch; within the loop, the programs can also store the number one in a variable in Basic or on the stack in Forth; add the loop index to itself — that is, double it; store the result in a Basic variable or on the Forth stack; multiply the loop index by itself and store the result. The results are shown in figure 4.

	Store 1 in a variable	Add a number to itself	Multiply a number by itself
Forth	2.5	4	31
Basic	16	19	28

Results shown in seconds.

Figure 4. Benchmarking Basic against Forth.

The multiplication is slower in Forth than in Basic because 32-bit arithmetic is double precision in Forth terms and is not coded as efficiently as 16-bit arithmetic. However, the other two cases show that Forth can be very much faster than Atom Basic — and Atom Basic is no slouch.

My overall impressions of Acornsoft Forth are very good. It is rich in facilities and well documented, and it is also very good value for money. The cassette is £11.50 and the manual £6 giving a total of £17.50 for a full system. This price compares very well for versions of Forth advertised to run on other machines. It should be attractive to many schools and colleges, as well as individual users. ■

PASCAL IS NOW available for most home micros, including the ZX-81. Some schools have been using it for quite a while now and the universities longer, making it available to a majority of *Your Computer's* readers. But what is Pascal and where did it come from?

Pascal was introduced 13 years ago by Niklaus Wirth. It had been preceded by Fortran — the world's first high-level programming language — in 1957, Cobol in 1960 and Basic in 1964. This makes Pascal the most modern of the popular high-level languages. Its origins lay in Algol, the algorithmic language, so it is ideal for solving complicated algorithms. Pascal could never be described as sloppy.

At first, a Basic programmer may feel restricted by the more complicated format of the Pascal Goto statement, but this is actually a good thing: this statement in Basic can often give rise to untidy hops about in the program which complicate its structure. Here is an extreme example:

```
10 GOTO 40
20 GOTO 60
30 GOTO 80
40 PRINT "1"
50 GOTO 20
60 PRINT "2"
70 GOTO 30
80 PRINT "3"
```

which could be boiled down to:

```
10 FOR A=1 TO 3
20 PRINT A
30 NEXT A
```

Perhaps none of us would make such a gross error, but this demonstrates how programs can be condensed into a loop to save memory and programming time, not to mention running time. Indeed, loops are the basis of the Pascal program structure. They serve to simplify it and give more user power.

The following sections serve as a simplified comparison between Basic and Pascal statements, and only begin to explain Pascal as a language in its own right.

The best place to start is always the beginning, and we will do so now, but the beginning of a Pascal program is not, as you might imagine, the first program statement. The program name and format are always declared first. The format of the program is the input and output status.

For example, if I were to write a program called Test and it was only used to output data then it would be declared as:

```
PROGRAM TEST(OUTPUT)
```

If the program Test used inputs and outputs then it would be declared as:

```
PROGRAM TEST(INPUT,OUTPUT);
```

In both cases the I/O status is within brackets and the program name is a single word containing no spaces, so that a program called *Your Computer* would not be accepted for compilation.

Next comes the declaration of all variables used in the program. Write down your program first. This way you can be sure that when you enter it you declare every variable. The four declarations with which we will deal are:

VAR	A letter which is a variable, that is, one which can contain any value.
CONST	A letter which has a pre-set value. For example, PI=3.1428571
PROCEDURE	A subroutine — fully discussed later.
TYPE	The type of a variable as described.

So if the program Test uses Pi and the variables X and Y then it would look like this:

```
PROGRAM TEST(INPUT,OUTPUT);
VAR X,Y:REAL;
CONST PI=3.1428571;
```

Having declared variables, constants and assuming that you have read on and declared all Types and Procedures, we are now ready to move on to the main body of the program which, believe it or not, begins with begin, thus:

```
BEGIN
```

which is unpunctuated. On, then, to the main Basic-Pascal statement comparisons.

Let: Most Basics do not require the reserved word Let, the supreme exception being the Sinclair Basics. To make the variable A equal to five in Basic would be:

```
LET A=5
```

or

```
A = 5
```

In Pascal we use the latter of the two, the only difference being in the equals sign:

```
A := 5
```

But that's not all. All Pascal statements, apart from the loops and jumps, end with a semicolon, so that our statement now becomes

```
A := 5;
```

The use of brackets is much the same as Basic, but many of the functions — Pi,Tan etc — have to be declared as constants, or otherwise as function-within-function statements.

The use of functions is not essential to someone learning the fundamentals of a language and so I would recommend anyone wishing to expand on this to read Findlat and Watts' book *Pascal — an introduction to methodical programming.*

Goto: This statement is used in Pascal in much the same way as it is in Basic, although Pascal has no line numbers. The Label statement replaces the line number with a numeric variable followed with a semicolon, and is declared at the beginning of the program as:

```
LABEL n;
```

where n is a number between 1 and 999. Having defined the Label it can now be jumped to from any Goto statement with the corresponding number. Each different label has to define individually at the beginning of the program. However, it is often simpler and more efficient to use conditional loops and jumps and normal loops.

For-Next and other loops: once again Pascal is almost the same as Basic so the use of For-Next should be quite elementary to a Basic user. The For statement is identical to the Basic with the exception of the equals sign which becomes := and three tag-on reserved words. These are simply Do and the routine encased with Begin and End; So a For-Next loop looks like this:

```
FOR A := 1 TO 10 DO
BEGIN
  routine
END;
```

Pascal has more Loops than the For-Next one. Some of these are available in a few Basics, but they rarely occur together. These other Loops are Repeat-Until, While-Do and If-Then-Do.



PAS

Repeat-Until will repeat a loop encased within Begin and End until a Boolean expression is satisfied. For example:

```
REPEAT
  routine
UNTIL A=10
```

The second loop is one which repeats a routine while a Boolean expression is satisfied. When the expression becomes "false" the loop will be exited at the End; statement. Thus:

```
WHILE A>10 DO
BEGIN
  routine
END;
```

The If-Then statement is self-explanatory to the Basic user. Again the Pascal version requires Do,Begin and the routine sandwiched between the latter and End;. For example:

```
IF A<10 THEN DO
BEGIN
  routine
END;
```

Dim and Dimensions: like Basic, one- and two-dimensional arrays are available in Pascal. These arrays have to be declared with the rest of the variables at the beginning of the program. If dimensioning A as 10 units length we would use:

```
A:ARRAY [1..10] OF REAL;
```

and if A were 5 by 10 this would look like:

```
A:ARRAY [1..5,1..10] OF REAL;
```

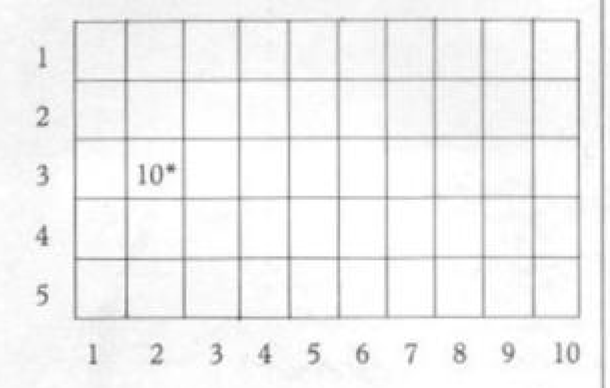
Having declared the size of the array we can now use it. There are only two changes from Basic in this case. The brackets are square instead of Basic's rounded ones and within the

CAL FOR BASIC USERS



Pascal has been around for over a decade, and can be obtained for a wide variety of personal microcomputers. Ian Maclean introduces Basic users to one of the most elegant high-level languages.

brackets the X and Y co-ordinates are reversed to comply with the reversed dimensioning statement. So a matrix grid drawn from this data would look like this:



Using the array A (5 × 10) our statement would be along the lines of, for example:

```
A [3,2] := 10
```

This means that on the grid the element which will become 10* will be found three down, from the top left-hand corner, and two right.

Rem: the Rem statement in Basic is extremely simple as it requires no argument, and the same applies to Pascal. The comment is encased within a bracket and star at each end, thus:

```
(*THIS IS A COMMENT*)
```

Note that the comment is not followed by any punctuation.

Input: the equivalent to Basic's Input in Pascal is Read and/or Readln. The two both come very close to being the same as Basic's version but differ slightly. Read will read in a string or numeric variable and allow the next data to be read from directly after it on the same line. Readln, however, reads from its start to the end of the line, including all blanks.

These two can be used together in an interesting combination. For example, a program has "told" the user that it requires the number of boys in a class and then the number of girls to be entered, in that order. The programmer has to anticipate worded answers, so he arranges Read and Readln to cater for this:

```
READ(BOYS);READLN;
READ(GIRLS);READLN;
```

Here the number of boys is read into "boys". Anything after that is read by Readln into a non-existent variable. So if "15 boys" were typed in, it would be recognised as just 15 because the "boys" would read away through the clever use of Readln. Note that the two variables (boys and girls) are within parentheses.

Print: as with Read and Readln, Print has two equivalents. These are Write and Writeln. These can be simulated in Basic by:

```
WRITE('IAN MCLEAN');
```

is the same as

```
PRINT "IAN MCLEAN";
```

and

```
WRITELN(X);
```

is the same as

```
PRINT X
```

Both Write and Writeln can be used to output strings and/or string variables. Variables inside the brackets must be separated by a comma, which does not space them into columns as in Basic.

Gosub: the word used to replace Gosub is Procedure. A procedure is usually defined at the beginning of the program, so be sure that you know exactly what each routine should contain. The Pascal jargon for a procedure is a sub-program, and in fact a procedure contains all of the "grown-up" features of its counterpart.

Firstly the procedure has to be named, again a single word containing no spaces. For example, we could call our procedure "Count" which would be represented in Pascal as:

```
PROCEDURE COUNT:
```

That is fine, but many sub-programs or routines require data from the main body of the program. For example, if a sub-program had been written to convert base 10 to binary, then it would need to be told the base 10 number. This variable would be indicated at the beginning of the procedure:

```
PROCEDURE CONVERT(VAR A:N);
```

which means that the variable A of a particular type N is used in the sub-program Convert. A procedural variable's type depends on whether it is real, an integer, a character or one of a number of types. Usually if it is a number then it will be real, as this covers all numbers. So if the variable A is real then its type (N) would be real. Therefore N would be declared as:

```
TYPE N:REAL;
```

Now, if there are any variables which the routine needs, like a Loop counter, they are declared in exactly the same kind of Var statement as in the main program. So if the procedure Convert contained a loop counter called C, then it would look like this:

```
PROCEDURE CONVERT(VAR A:N);
VAR C:INTEGER;
```

Of course, there is nothing to prevent you from using constants inside of your procedure too. Procedures end with End; always.

The sub-program can now be called from any point in the program, including from within other sub-programs. This is achieved by simply using the name followed by a semi-colon. For example:

```
COUNT;
```

But we also have another type of procedure which requires data input from the main program. This was shown in the procedure Convert which required A as the number to be converted. When calling a routine this variable is always given in brackets to tell the computer what the particular routine requires in the way of data. So that our line to call Convert looks like this:

```
CONVERT(A);
```

which also makes sense in English.

Finally, a program written in Pascal to demonstrate some of the language briefly covered in this article. This may give some idea of when and where to use certain statements.

```
PROGRAM GRAPH(INPUT,OUTPUT);
VAR
A,B,D:INTEGER;
C:ARRAY[1..10] OF INTEGER;
PROCEDURE DRAW (E:N);
VAR F:INTEGER;
BEGIN(*PROCEDURE*)
FOR F:=1 TO E DO
BEGIN
WRITE ('*');
END;
WRITELN;
END;(*PROCEDURE*)
BEGIN(*MAIN PROG.*)
FOR A:=1 TO 10 DO
BEGIN
WRITELN('ENTER VALUE NO.',A);
READLN(B);
C[A]:=B;
END;
FOR A:=1 TO 10 DO
BEGIN
D:=C[A];
DRAW(D);
END;
(*END OF PROG.*)
END.
```

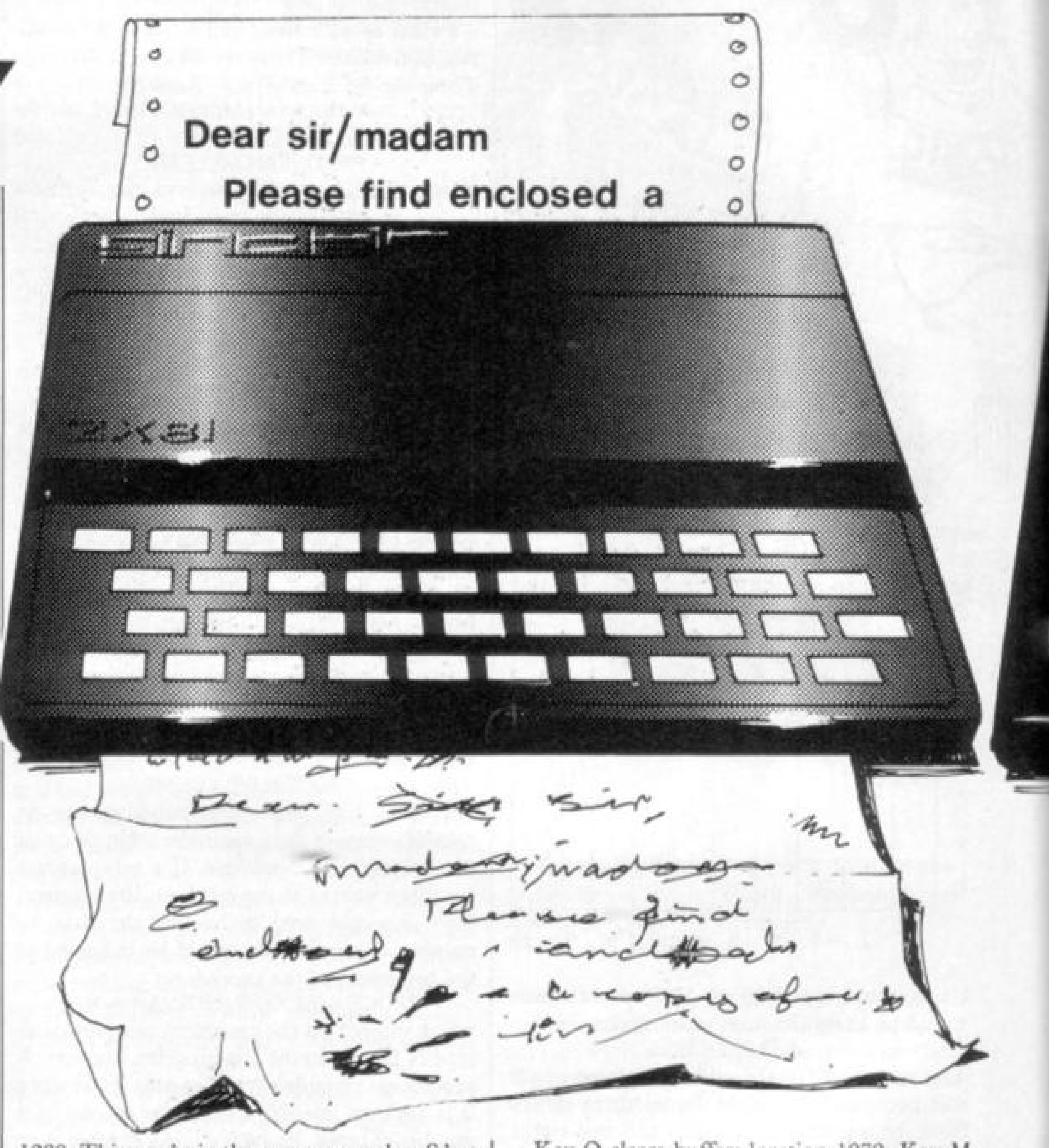
This program inputs 10 numbers and then prints out a horizontal bar graph to represent them. Note that the End. at the end of the program ends with a full stop; this distinguishes it from normal loop endings. ■

Machine	Company	Price	Where obtainable
ZX-81	Control Technology	POA	39 Glouster Road, Gee Cross, Hyde, Cheshire SK14 5JG.
MZ-80K	Sumlock	£51.75	Royal London House, 198 Deansgate, Manchester M3 3NE.
TI-99	Texas Dealers	£30 (approx)	Texas high street dealers.
Atom	Pascal not ready yet.		
BBC	Pascal not ready yet.		
Vic-20	No news as yet of Pascal.		

Wordy for the ZX-81 by A F Whiddet, and Spectrum Processor by Robert Daren will help you format deathless prose.

ZX WORD PR

ZX-81 WORDY



THIS PROGRAM provides ZX-81 users with the functional services of a word-processing facility. Written in Basic, it makes full use of the ZX-81's superb string-handling techniques. The program needs 14.7K of RAM but provides the user with 6,400 bytes of character storage available in a paged format of 10 pages containing 640 characters.

Unlike many word-processor programs for standard business microcomputers, Wordy communicates with its member pages via a buffer string, allowing data to be manipulated in easily-handled amounts. This increases speed and flexibility.

The program is made up of five subroutines.

The first option is the Save routine. This allows the user to save data and programs on cassette under a user-defined file name. The second option is the subroutine allowing the user to send a specified page which is numbered between 1 and 10 to the line printer. Entering 11 would print the entire text memory.

Writing mode is the third option. First, enter the desired page number. The ZX-81 can now be used like a typewriter except the Newline key is used instead of the space key. The space key is used to break out of the program. To operate the Newline facility push Newline then shift. To delete the last character entered, press shift D. To put the machine into Editing mode — the fourth option — without homing the cursor, press shift W.

In the program's Editing mode 21 keys are redesignated so they can be used to manipulate the text pages. The system appears to handle the entire text but in fact only deals with the specified page at any one time.

The redesignated keys are: keys 5 to 8 inclusive — those operate the cursor in the direction of the arrows on the keys; the line location is 920. These keys change the variable POS by -1,32, and negative 32,1, respectively.

Key D is the delete function. This deletes the character on the left of the cursor position; location 2200. This overlaps the positions from the beginning of the page to two spaces before the cursor. Use of this strips the first character from the buffer memory.

Key S adds a space to the left of the cursor position; location 1100. This strips the last character from the page, places it into the buffer, then adds the space before the cursor.

Key H homes the cursor; location 950. This sets the variable position to 1. Key L adds a line of spaces to the left of the cursor; location 1200. This works in the same way as key S but strips 32 characters instead.

Key 1 allows manipulative positioning of a specified amount of text. This can be from 0 to 639 characters; location 1800. This function strips the text within A$, replaces it into C$ then removes the contents of the text from A$, emptying B$ if full.

Key P drops the text held in C$ when used with key 1; location 1900. This transfers the end of A$ into B$, and places the contents of C$ between this cursor and the character on the left.

Key I inserts inputted text between the cursor and the character on the left; location 1300. Input X$ calculates length in variable A. It strips the appropriate end off A$ and stores it in the B$ and then dumps X$ to the left of the cursor.

Key T changes the character under the cursor to the character on the next key pressed; location 1700. This replaces A$ (X,POS) with the Inkeyed character.

Key O clears buffer; location 1070. Key M speeds up the cursor using movement keys. Newline is used to exit; location 8600. This operates in a similar manner to keys 5 to 8.

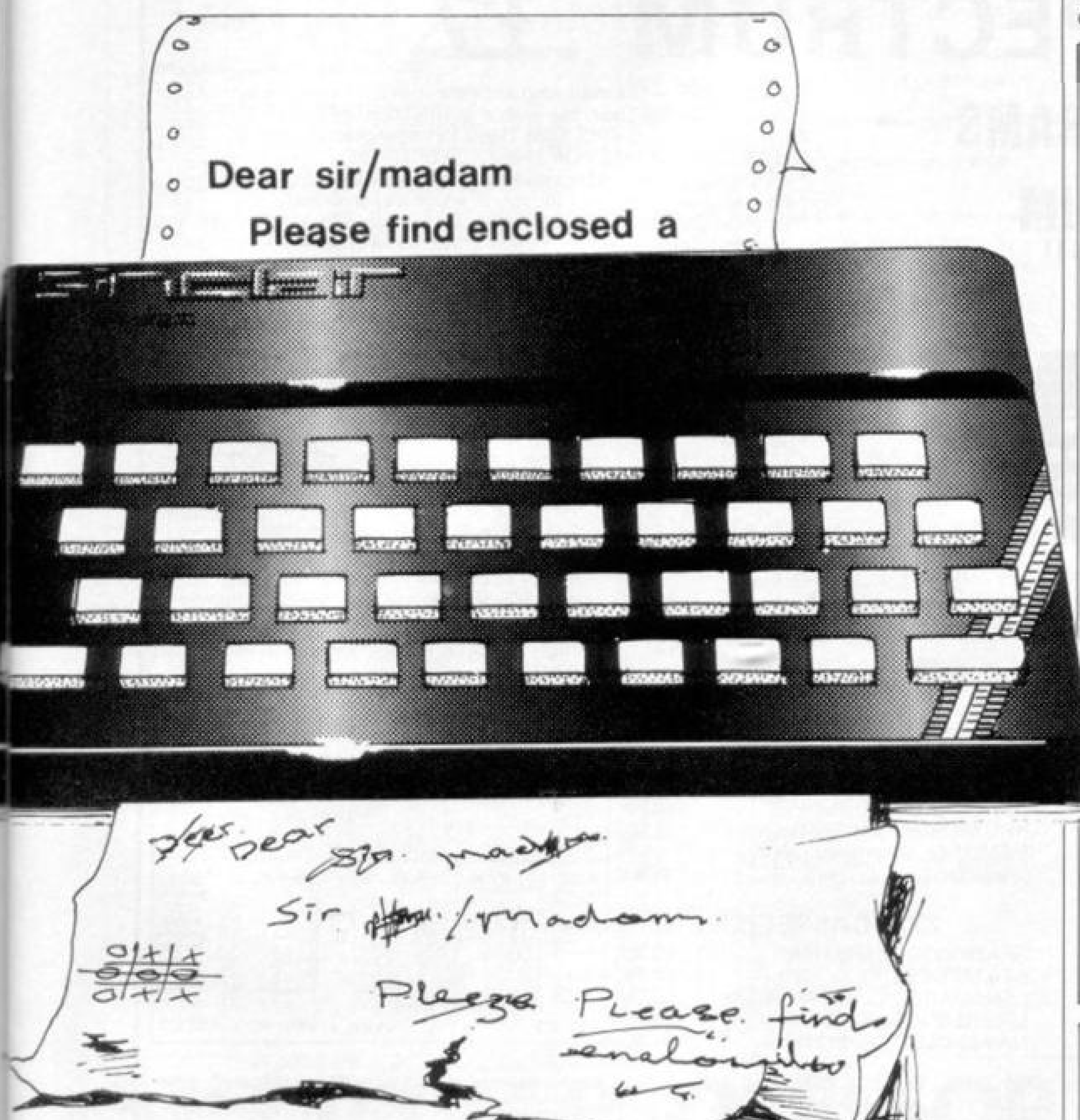
Key J justifies text to appear as even-ending lines in printed-matter fashion; location 7000. It works out the number of spaces at the end of the line and stores them in A; it then goes through that line of text dumping one space extra between words and in so doing decreases A by 1 until it reaches 0.

Key A advances a page through stored text; location 1500. It then restores the buffer, and adds 1 to X.

Key B steps back a page; location 1600. It then restores buffer, subtracts 1 from X. Key W exits from writing mode leaving the cursor in the previous position; location 3500. It restores the buffer and goes to writing mode.

Key E defaults to menu — exits; location 2400. It replaces the buffer and returns to the menu. Key R replaces the buffer; location 2000. Key C clears the character underneath

ROCESSING



cursor position; location 1400. This is the same as key T but uses an empty string instead of Inkey$.

Option five is the method by which pages of text are clear of previously inputted material. To clear a page, enter its number.

Due to the fact that the justification function within the Editing mode is indiscriminate, it is necessary to use two control characters to protect specified lines from the justification technique. These are: > which excepts that line from justification, and < which stops justification and returns to the Edit mode.

Missing out the final control character in a half-filled page will cause a substantial delay before the machine returns to Editing mode. During this time, it is possible the string will become corrupt and cause disalignment of justification.

After loading the cassette the system will go directly into the menu offering the five options. To enter large amounts of text, press 3. The system will then ask you to enter the page to write on. If you have not entered any text into the page storage, start at page 1. If you have previously inserted pages of data then enter the probable page number at the end of the text.

If you wish to continue where you left off, enter Editing mode by shift W and move the cursor down to the position you wish to start writing from. After this press W to take you back into Writing mode, leaving the cursor in the same position. This will then allow you to continue entering text.

In Editing mode most of the functions are obvious in their use; some however may appear obscure at first glance. In the function of "Pick up and drop" of text codes 1 and P, the facility allows the user to transpose up to 639 characters at a time by moving the cursor down to the last character needed to be picked up, by pressing 1, followed by the length of text required to be dropped.

The justification routine is best left until the text pages are input and edited to the operator's complete satisfaction prior to final print out of usable hard copy.

As regards program structures there are 18 variables controlling the program. This small number beneficially extends the character storage capacity. Some variables are used more than once but for different purposes during operation. The listing therefore appears confused in its form, so this table should clarify the position.

Variable	Function
A	Controls length of string splitting.
A$	Holds text.
B	Used as loop counter during buffer restore.
B$	Buffer store.
C$	Used as temporary store during buffer restore.
D$	Contains string used for pick up and drop.
POS	Holds location of cursor in A$.
UU	Increases POS to Modular 32 and so acts as Newline.
WC	Cursor column.
WL	Cursor line.
X	Holds page number.
X$	General input of information.
Z$	Used to save under file name.
F	Delay loop.
AS	
Z	Used to control justification.
Y	
GH	

Line	Routine
10- 60	Initiation of main variables.
70- 140	Save routine.
160- 330	Menu plus directional sorting routine.
350- 495	Print-out routine.
500- 750	Writing routine.
800-1090	Main-editing sorter.
1110-2470	Editing subroutines.
2502-2590	Buffer-restore system.
4000-4040	Page-clearing routine.
7005-8020	Justification.
8605-8690	Fast-movement routine.
9000-9999	Error trapping and messages.

```
  10 REM     -WORDY 3
             -A.F.WHIDDETT
             -24.3.82
  20 DIM A$(10,640)
  30 LET B$=""
  40 LET D$=""
  50 LET POS=1
  60 LET PAGE=1
  70 PRINT "WORDY3 ENTER PROGRAM
 NAME-"
 110 INPUT Z$
 115 IF Z$="" THEN GOTO 9050
 120 PRINT "SET UP TAPE DECK THE
N PRESS(N/L)"
 130 INPUT X$
 140 SAVE Z$
 160 CLS
 170 PRINT "████████████████████████████████"
 180 PRINT "   WORDY 3 BY A.F.WH
IDDETT"
 190 PRINT "████████████████████████████████"
 200 PRINT AT 4,2;"  1:SAVE ON T
APE"
 210 PRINT AT 6,2;"  2:SEND TO P
RINTER"
 220 PRINT AT 8,2;"  3:WRITE PAG
E"
 230 PRINT AT 10,2;"  4:EDIT PAG
E"
 240 PRINT AT 12,2;"  5:CLEAR PA
GE"
 245 PRINT AT 14,0;"    ENTER OP
TION (1 TO 4)"
 250 PRINT AT 14,25;"█"
 260 LET X$=INKEY$
 270 IF X$="1" THEN GOTO 070
 280 IF X$="2" THEN GOTO 350
 295 PRINT AT 14,25;"?"
 300 IF X$="3" THEN GOTO 500
 310 IF X$="4" THEN GOTO 800
 320 IF X$="5" THEN GOTO 4000
 330 GOTO 250
 350 PRINT "ENTER PAGE TO BE PRI
NTED OUT"
 370 INPUT X
 380 IF X=11 THEN GOTO 420
 390 IF X=12 THEN GOTO 160
 395 IF X>11 OR X<1 THEN GOTO 90
30
 400 LPRINT A$(X)
 410 GOTO 430
 420 FOR X=1 TO 10
 422 LPRINT A$(X)
```

(continued on page 55)

(continued from page 53)

```
 424 NEXT X
 430 PRINT "  ANYMORE"
 440 LET X$=INKEY$
 480 IF X$="Y" THEN GOTO 350
 490 IF X$="N" THEN GOTO 150
 495 GOTO 440
 520 PRINT "ENTER PAGE FOR WRITI
NG ON"
 530 INPUT X
 540 IF X>10 OR X<1 THEN GOTO 90
30
 545 LET POS=1
 550 PRINT AT 21,0;" MODE:WRITIN
G    ";AT 21,22;"PAGE:";X
 580 PRINT AT 20,0;"[redacted]"
 600 PRINT AT 0,0;A$(X)
 605 POKE 16441,20
 606 POKE 16442,30
 620 LET WL=INT (POS/32)
 630 LET WC=POS-WL*32-1
 635 IF POS/32=INT (POS/32) THEN
 GOSUB 8000
 640 PRINT AT WL,WC;"█"
 650 IF INKEY$="" THEN GOTO 650
 660 LET X$=INKEY$
 670 IF X$=CHR$ 224 THEN GOTO 15
0
 675 IF X$=CHR$ 121 THEN GOTO 73
1
 680 IF X$=CHR$ 118 THEN GOTO 74
0
 685 IF X$=CHR$ 228 THEN GOTO 30
00
 686 IF X$=CHR$ 217 THEN GOTO 85
0
 687 IF X$=CHR$ 121 THEN GOTO 85
00
 690 LET A$(X,POS)=X$
 700 PRINT AT WL,WC;A$(X,POS)
 710 LET POS=POS+1
 720 IF POS>640 OR POS<1 THEN GO
TO 3600
 730 GOTO 620
 731 LET UU=(WL+1)*32-POS
 732 LET POS=POS+UU+1
 733 PRINT AT WL,WC;A$(X,POS-UU-
1)
 734 GOTO 720
 740 LET X$=" "
 750 GOTO 690
 810 PRINT "ENTER PAGE FOR EDITI
NG"
 820 INPUT X
 830 IF X>10 OR X<1 THEN GOTO 90
30
 840 LET POS=1
 850 PRINT AT 20,0;"[redacted]"
 855 PRINT AT 21,0;" MODE:EDITIN
G  ";AT 21,22;"PAGE:";X
 860 PRINT AT 0,0;A$(X)
 870 LET WL=INT (POS/32)
 880 LET WC=POS-WL*32-1
 885 IF POS/32=INT (POS/32) THEN
 GOSUB 8000
 890 PRINT AT WL,WC;CHR$ (128+CO
DE A$(X,POS))
 900 PRINT AT WL,WC;A$(X,POS)
 905 IF INKEY$="" THEN GOTO 890
 910 LET X$=INKEY$
 920 LET POS=POS+(X$="8")-(X$="5
")+32*(X$="6")-32*(X$="7")
 930 IF POS>640 OR POS<1 THEN GO
TO 9070
 940 IF CODE X$<37 AND CODE X$>3
2 THEN GOTO 870
 950 IF X$="H" THEN LET POS=1
 955 IF X$="D" THEN GOTO 2200
 960 IF X$="S" THEN GOTO 1100
 970 IF X$="L" THEN GOTO 1200
 980 IF X$="A" THEN GOTO 1500
 990 IF X$="I" THEN GOTO 1300
1000 IF X$="C" THEN GOTO 1400
1010 IF X$="B" THEN GOTO 1600
1020 IF X$="T" THEN GOTO 1700
1030 IF X$="1" THEN GOTO 1800
1040 IF X$="P" THEN GOTO 1900
1050 IF X$="R" THEN GOTO 2000
1060 IF X$="E" THEN GOTO 2400
1070 IF X$="O" THEN LET B$=""
1075 IF X$="J" THEN GOTO 7000
1080 IF X$="U" THEN GOTO 3500
1085 IF X$="M" THEN GOTO 8600
1090 GOTO 870
1100 LET B$=A$(X,640)+B$
1120 LET A$(X)=A$(X,1 TO POS-1)+
" "+A$(X,POS TO 640)
1130 LET POS=POS+1
1135 IF LEN B$>200 THEN GOTO 909
0
1140 GOTO 860
1210 LET B$=A$(X,640-32 TO 640)+
B$
1220 LET A$(X)=A$(X,1 TO POS-1)+
"
 "+A$(X,POS TO 640)
1230 IF LEN B$>200 THEN GOTO 909
0
1240 GOTO 860
1310 PRINT AT 21,0;"ENTER TEXT
 "
1320 INPUT X$
1330 LET A=LEN X$
1340 LET B$=A$(X,640-A TO 640)+B
$
1350 LET A$(X)=A$(X,1 TO POS-1)+
X$+A$(X,POS TO 640)
1360 IF LEN B$>200 THEN GOTO 909
0
1370 GOTO 850
1410 LET A$(X,POS)=" "
1420 GOTO 860
1510 GOSUB 2500
1515 IF X=10 THEN GOTO 9010
1520 LET X=X+1
1530 GOTO 850
1610 GOSUB 2500
1615 IF X=1 THEN GOTO 9010
1620 LET X=X-1
1630 GOTO 850
1710 PAUSE 100
1720 IF INKEY$="" THEN GOTO 1720
1740 LET A$(X,POS)=INKEY$
1750 GOTO 860
1810 PRINT AT 21,0;"AMOUNT?"
1820 INPUT A
1830 LET D$=A$(X,POS-A TO POS-1)
1840 LET A$(X)=A$(X,1 TO POS-A-1
)+A$(X,POS TO 640)
1850 GOTO 850
1910 LET A$(X)=A$(X,1 TO POS-1)+
D$+A$(X,POS TO 640)
1920 LET D$=""
1930 GOTO 860
2010 GOSUB 2500
2020 GOTO 150
2300 IF B$="" THEN LET A$(X)=A$(
X,1 TO POS-2)+A$(X,POS TO 640)
2310 IF B$<>"" THEN LET A$(X)=A$
(X,1 TO POS-2)+A$(X,POS TO 640)+
B$(1)
2320 IF B$<>"" THEN LET B$=B$(2
TO )
2330 LET POS=POS-1
2340 GOTO 860
2410 GOSUB 2500
2420 GOTO 150
2502 IF B$="" THEN RETURN
2505 FAST
2510 LET A=LEN B$
2520 FOR B=X+1 TO 9
2530 LET C$=A$(B,640-A TO 640)
2540 LET A$(B)=B$+A$(B,1 TO 640-
A-1)
2550 LET B$=C$
2560 NEXT B
2570 LET B$=""
2580 SLOW
2590 RETURN
3000 LET POS=POS-1
3005 LET A$(X,POS+1)=" "
3010 GOTO 600
3500 GOSUB 2500
3510 GOTO 550
3600 LET X=X+1
3610 IF X>10 THEN GOTO 9010
3615 LET POS=1
3620 GOTO 550
4000 PRINT "  PAGE TO CLEAR?"
4010 INPUT X
4020 IF X>10 OR X<1 THEN GOTO 90
30
4030 LET A$(X)=""
4040 GOTO 150
7005 LET GH=0
7007 LET AS=2
7010 FAST
7030 FOR Z=1 TO 640-32 STEP 32
7040 FOR Y=Z+31 TO Z STEP -1
7042 IF A$(X,Y)="(" THEN GOTO 71
15
7050 IF A$(X,Y)=")" THEN GOTO 71
00
7052 IF A$(X,Y)<>" " THEN GOTO 7
065
7055 LET GH=GH+1
7060 NEXT Y
7065 LET A$(X)=A$(X,1 TO Z+31-GH
)+A$(X,Z+31+1 TO 640)
7070 FOR Y=Z TO Z+31
7075 IF GH=0 THEN GOTO 7100
7080 IF A$(X,Y)=" " THEN GOSUB 7
500
7090 NEXT Y
7095 IF GH<>0 THEN GOTO 7800
7100 LET GH=0
7102 LET AS=2
7105 NEXT Z
7115 SLOW
7120 GOTO 850
7510 LET A$(X)=A$(X,1 TO Y-1)+"
"+A$(X,Y TO 640)
7515 LET GH=GH-1
7518 LET Y=Y+AS
7520 RETURN
7800 LET AS=AS+1
7810 GOTO 7070
8000 LET WC=31
8010 LET WL=WL-1
8020 RETURN
8605 FAST
8610 LET WL=INT (POS/32)
8615 FAST
8620 LET WC=POS-WL*32-1
8630 IF POS/32=INT (POS/32) THEN
 GOSUB 8000
8640 PRINT AT WL,WC;"█"
8645 SLOW
8650 IF INKEY$="" THEN GOTO 8650
8655 PRINT AT WL,WC;A$(X,POS)
8660 LET X$=INKEY$
8665 IF X$=CHR$ 118 THEN GOTO 85
0
8670 LET POS=POS+(X$="8")-(X$="5
")+32*(X$="6")-32*(X$="7")
8690 GOTO 8610
9010 PRINT AT 21,0;"(ERROR)YOU H
AVE USED ALL FILES"
9020 GOTO 9910
9030 PRINT AT 21,0;"(ERROR)THERE
 IS NO SUCH PAGE    "
9040 GOTO 9910
9050 PRINT AT 21,0;"(ERROR)PROGR
AM NAME IS INVALID"
9060 GOTO 9910
9070 PRINT AT 21,0;"(ERROR)RUNNI
NG INTO NEXT PAGE"
9080 GOTO 9910
9090 PRINT AT 21,0;"(ERROR)WORKI
NG BUFFER IS FULL"
9100 GOSUB 2500
9110 GOTO 9910
9120 PRINT AT 21,0;"ERROR)TEXT I
NSERTION IS TO LARGE"
9130 FOR F=1 TO 20
9140 NEXT F
9150 GOTO 850
9910 PAUSE 100
9920 GOTO 150
9999 REM (C) A.F.WHIDDETT
```

SPECTRUM PROCESSOR

HERE IS A short Basic word-processing program which will enable you to provide neat, left- and right-justified text.

This will enable you to put the write-up, your listings and your program on to tape, check them, and post the material on a cassette. There is enough space for 1,000 words.

To use the Spectrum word processor, first enter your text as a data string within a data statement with quotation marks.

Next, write each paragraph in a separate data statement. Having done this you can write each word in full. Do not use the Sinclair internal keywords to save space.

To produce a single line space, type a single space within quotation marks, for example Data ‘ ’. The symbol ‘ is used here as quotation marks.

Indent each new paragraph by four spaces. Always follow a full stop, comma, or any other punctuation with a space.

If you want a formatted display, produce each line by a single Data statement — it is easier.

Replace Pause 350 with Copy in line 190 if you have a printer.

The Spectrum word processor copies a screen full of data at a time. This seems to cause less of a strain on the printer than copying a line at a time.

The listing for the word processor is given in figure 1.

d; number of lines printed on the screen
c; number of characters short in unprocessed line
f; loop constant stepping back along the line looking for spaces
a$; the string variable to be processed
b$; the temporary string while locating suitable end point for line
c$; processed string line with modified spacing
g$; space

The 21 Data statements in lines 93 to 95 ensure that the screen is copied before the ‘E out of Data’ statement appears.

```
  93 DATA " ": DATA " ": DATA "
": DATA " ": DATA " ": DATA " ":
 DATA " "
  94 DATA " ": DATA " ": DATA "
": DATA " ": DATA " ": DATA " ":
 DATA " "
  95 DATA " ": DATA " ": DATA "
": DATA " ": DATA " ": DATA " ":
 DATA " "
  97 LET d=0
 100 READ a$
 105 IF LEN a$>32 THEN GO TO 120
 110 PRINT a$
 112 GO SUB 180
 115 GO TO 100
 120 LET c=0
 125 IF c=32 THEN GO TO 150
 130 LET b$=a$(32-c)
 135 IF a$(33-c)=" " OR b$=")" O
R b$="," OR b$="." OR b$=":" OR
b$=";" OR b$="?" THEN GO TO 155
 140 LET c=c+1
 145 GO TO 125
 150 LET c=0
 155 LET c$=a$( TO 32-c)
 156 LET a$=a$(33-c TO )
 157 IF a$(1)=" " THEN LET a$=a$
(2 TO )
 160 GO SUB 200
 165 GO SUB 180
 170 GO TO 105
 180 LET d=d+1
 185 IF d<22 THEN RETURN
 190 PAUSE 350: CLS : LET d=0: R
ETURN
 200 LET g$=" "
 205 FOR f=LEN c$ TO 1 STEP -1
 210 IF LEN c$>31 THEN GO TO 240
 215 IF c$(f)=" " THEN GO TO 220
 216 NEXT f
 218 GO TO 205
 220 LET c$=c$( TO f-1)+g$+c$(f
TO )
 221 LET f=f-1
 225 LET c=c-1: IF c<=0 THEN GO
TO 240
 230 GO TO 216
 240 PRINT c$: RETURN
```

Figure 1. Robert Daren's Spectrum Processor.

THROUGH THE CATACOMBS

As you wander Patrick Edmond's catacombs in search of gold coins, phantoms and evil winds conspire to snuff out you and your candle.

THIS GAME uses high-resolution graphics, and a joystick option is available too. If you are not working with a joystick, then use the following keys: Y to move up, B to move down, G to move left, and H to move right. You are in control of a human figure, an explorer, whose aim is to collect gold coins or dots and the following bonuses from the catacombs:

Object	Colour	Points
Orange	White	10
Cherries	Red	20
Pear	Cyan	30
Spider	Purple	40
Apple	Green	50
Crystal	Blue	60
Lemon	Yellow	70
Baby ghost	Blue/Green	10

The white orange — 10 points — doubles the explorer's speed.

After 30 seconds the explorer's candle is snuffed by a mysterious breeze, so he can not see to pick up the gold coins. He must then reach one of the sacred bells positioned in two corners, to relight it. At all times the explorer must avoid the ghosts, and occasionally the flickering block at the crossroads, otherwise he may lose a life, of which he has three. The game ends when he has lost all his lives. Press a key to restart. Be sure to switch off the tape play button before using joystick.

```
0 E=3
1 DIMX%(506),Q(8,2)
2 RESTORE:FORI=5TO8:FORJ=0TO2:READQ(I,J):NEXTJ,I
3 DATA4,3,1,4,1,2,4,2,3,3,2,1
4 Z=7679:Y(1)=1:Y(2)=22:Y(3)=-1:Y(4)=-22:Y=38399
5 VN=36874:PRINT"[illegible]  JOYSTICK ? (Y/N) ":POKE36879,8:Y=38399:SE=197
6 GETA$:IFA$=""THENGOSUB500:GOTO6
7 POKE36878,15
8 IFA$="Y"THENSE=37137:AS=1:POKE37139,0:POKE37154,127
10 FORI=0TO22:READA$:FORJ=1TO22:X%(I*22+J)=ASC(MID$(A$,J,1))-48
11 B=204:K=1:IFX%(I*22+J)=9THENB=160:K=4
12 POKEZ+I*22+J,B:POKE38399+I*22+J,K:NEXTJ,I
20 DATA9999999999999999999999,9400194019401940008019
21 DATA9099302930290909030909,9319999999990909090909
22 DATA9960000000190960293079,9909999999090909999909
23 DATA9450801940502909940029,9099090909909960079999
24 DATA9094290089408079909999,9090993029090909960199
25 DATA9385199999090909909099,9909380194296056079319
26 DATA9429909307990990909909,9099909993082990930029
27 DATA9319450199909990999999,9909099308000805800000
28 DATA0029319990909099099999,9999909407909014580019
29 DATA9400079090009090909909,9099909090909607931909
30 DATA9094079090960290990909,9302930293029993005029,9999999999999999999999
50 IFOA=0THENGOSUB1000
51 OA=1
70 P1=25:D1=1:M1=PEEK(Z+P1):POKEY+342,3:F1=1
80 P2=482:D2=3:M2=PEEK(Z+P2)
```

E VIC MBS



```
90 P3=469:D3=3:M3=PEEK(P3+Z)
95 B=2:TI$="000000":POKEZ+24,205:POKEZ+483,205:POKEY+24,7:POKEY+483,7
96 A=INT(RND(1)*7)+210:POKEZ+42,A:POKEY+42,A-209:POKEZ+465,A:POKEY+465,A-209
97 A=RND(1)*9+150
100 POKEZ+P1,M1:P=P1:D=D1:GOSUB892
101 A=RND(1)*20+150
110 P1=P1+V(D):D1=D:M1=PEEK(Z+P1)
115 IFM1=200THENM1=M3:GOSUB800
116 IFM1=202THENM1=203:POKEY+P1,6
120 POKEP1+Z,201:POKEVN+2,0
130 POKEZ+P2,M2:P=P2:D=D2:GOSUB892
140 P2=P2+V(D):D2=D:M2=PEEK(Z+P2)
145 IFM2=200THENM2=M3:GOSUB600
146 IFM2=201THENM2=203:POKEY+P1,5
150 POKEP2+Z,202
160 FORF=1TOF1:POKEZ+P3,M3:P=P3:D=D3:GOSUB890
161 POKEY+P3,1
170 P3=P3+V(D):D3=D:M3=PEEK(Z+P3)
176 IFTI$>"000030"ANDB=2THENPOKEVN+3,240:FORI=1TO200:NEXTI:POKEVN+3,3:B=3
177 IFM3=160THENP3=P3-V(D3):M3=PEEK(Z+P3):GOTO180
178 IFM3>209THENSC=SC+(M3-209)*10:GOSUB600:GOTO180
179 ONM3-200GOSUB400,410,420,430,440
180 POKEZ+P3,200:POKEY+P3,B-1
181 NEXTF
185 PRINT"■■■■■■■";SC;TAB(16);"▣ ↑";E:POKEY+14,B-1:POKEZ+14,331-B*57
186 POKEZ+342,206:IFRND(1)>.6THENPOKEZ+342,160:IFRND(1)>.8THENPOKEZ+342,202
190 IFW<239THEN100
199 POKEVN+2,0
200 W=0:FORI=1TO120:FORJ=-2TO2:POKEVN+2,130+I+J:NEXTJ,I:POKEVN+2,0
201 GOTO2080
400 M3=M1:GOSUB800:RETURN
410 M3=M2:GOSUB800:RETURN
420 M3=206:GOSUB700:RETURN
430 IFB<>2THENRETURN
431 M3=206:SC=SC+1:W=W+1:POKEVN+2,A:IFF1=2THENPOKEVN+2,235
432 RETURN
440 GOSUB500:RETURN
500 POKEVN+2,240:FORI=15TO0STEP-.3:POKE36878,I:NEXTI:POKEVN+2,0:B=2:TI$="000000"
510 POKEVN+2,237:FORI=15TO0STEP-.3:POKE36878,I:NEXTI:POKEVN+2,0:POKE36878,15:RET
URN
600 FORI=0TO2:POKEVN+I,200:POKEVN+I-1,0:FORJ=1TO100:NEXTJ,I:IFM3=210THENF1=2
605 M3=206
610 FORI=2TO0STEP-1:POKEVN+I,200:POKEVN+I+1,0:FORJ=1TO100:NEXTJ,I:POKEVN,0:RETUR
N
700 POKEVN,250:POKEVN+2,145:FORI=1TO100:NEXTI:POKEVN,0:POKEVN+2,0:SC=SC+10:RETUR
N
800 FORJ=225TO0STEP-200:FORI=1TO3:POKEZ+P3,RND(1)*3+207:POKEVN+I,J:NEXTI
810 FORI=1TO100:POKEZ+P3,RND(1)*3+207:POKEY+P3,RND(1)*7+1:NEXTI,J
815 E=E-1:IFE<1THEN2050
820 RETURN
890 IFX%(P)>4THEN960
892 ONX%(P)+1GOTO900,910,920,930,920,950,950,950,950
900 RETURN
910 D=D-SGN(D-2):RETURN
920 D=5-D:RETURN
930 D=D+(D*2-5):RETURN
950 D=Q(X%(P),INT(RND(1)*3)):RETURN
960 T=PEEK(SE):IF(T=11ORT=250)ANDX%(P3)<>8THEND=4
964 IFAS=1ANDX%(P3)<>7ANDPEEK(37152)=119THEND=1
965 IFT=43ANDX%(P3)<>7THEND=1
970 IF(T=35ORT=246)ANDX%(P3)<>5THEND=2
975 IF(T=19ORT=238)ANDX%(P3)<>6THEND=3
977 IF(T=64ORT=254)ANDPEEK(37152)=247THEND=0
980 RETURN
1000 FORI=0TO7:POKE6400+I,PEEK(34048+I):NEXT:POKE36866,PEEK(36866)OR128:POKE3686
9,253
1005 FORI=6528TO6608:POKEI,PEEK(32768+I-5120):NEXT
1010 FORI=6720TO6863:READA:POKEI,A:NEXTI:RETURN
1020 DATA56,56,16,124,186,56,40,40,124,254,182,254,254,254,254,170
1030 DATA124,254,218,254,254,254,254,170,0,28,62,42,62,62,62,42
1040 DATA0,0,0,0,0,24,24,0,0,24,60,60,60,60,126,16
1050 DATA0,0,0,0,0,0,0,0,0,0,24,24,0,0,0,0,0,60,36,36,60,0,0
1060 DATA0,126,66,66,66,66,126,0,0,60,110,126,126,126,60,0
1070 DATA255,223,239,247,233,153,159,255,32,24,24,60,94,126,60,0
1080 DATA0,0,254,84,124,124,170,0,52,8,20,62,62,62,28,0
1090 DATA255,195,145,181,181,145,195,255,0,0,60,126,126,60,0,0
2000 DATA8,16,32,16,48,51,181,122
2050 FORI=0TO22:A=(INT(I/2)=I/2)*5+7:POKEVN+2,(INT(I/2)=I/2)*40+190:POKEY+1+I*22
,A
2051 POKEY+I*22+22,A:FORJ=1TO200:NEXTJ,I
2060 SC=0:W=0:E=3:POKEVN+2,0
2061 IFPEEK(197)=64THEN2061
2070 IFOA=0THEN1
2080 FORI=1TO506:B=204:K=1:IFX%(I)=9THENK=4:B=160
2090 POKEZ+I,B:POKEY+I,K:NEXTI:GOTO70

READY.
```

■

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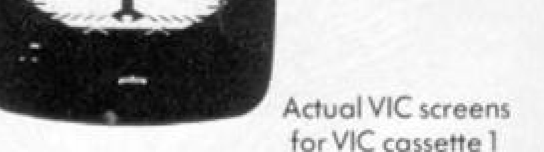
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BASIC DICTIONARY

This dictionary, compiled by Tony Edwards, will explain the function of common Basic words as used in popular machines, enabling you to work out your own machine's equivalent. A useful complement to our recent series on Basic dialect translation.

BASIC DICTIONARY

A

A. Used in TRS-80 Level I and in some versions of Tiny Basic as an abbreviation for the ABS function. *See ABS*

ABS An almost universal function which returns the absolute value of the argument, that is, the expression in brackets following it. A number's absolute value is its numerical value without an accompanying + or − sign. This is an ANSI — American National Standards Institute — standardised word from the minimum Basic vocabulary.

ACS This is a function giving the arc-cosine of its argument in radians. It is rarely found but is in the extensions to BBC Basic.

ADVAL A BBC Basic function which returns the last value of the variable which follows it.

AND An operator used between two statements in logical arithmetic when both must be complied with to pass the test. For example:

```
10 IF X = 0 AND Y = 0 THEN 1000
```

Some computers use AND to compute the binary logical AND of two statements using Boolean algebra, rather than to make a direct comparison of value. An article on translating binary logic was published in *Your Computer* August 1982 page 58. This provides more details. This word can also be used to check the veracity of two statements on some micros. For example:

```
10 PRINT X = 0 AND Y = 0
```

will print −1 (True) if both X and Y are zero and 0 (False) if they are not.

ASC This function converts the first character of a string argument into the decimal equivalent of its standard ASCII code. If the argument is a null string it usually returns the value −1. In many cases the string argument may be longer than one character, but only the first character is evaluated and converted. Users of ZX-81 and ZX Spectrum machines will recognise this function as the equivalent of their CODE function.

ASN This is a function found in a few Basics, including BBC Basic, which returns the arc-sine of its argument, usually in radians. If it is not available to you, its direct equivalent is:

```
ATN(X/SQR(-X*(X+1)))
```

This uses the more readily available function ATN. *See ATN*

AT This word is used in conjunction with PRINT to print from a specific location on the VDU, in TRS-80 Level I Basic. In other interpreters the symbol @ is used.

ARCTAN This is the ZX-81 equivalent of ATN. *See ATN*

ATAN A variant of ATN. *See ATN*

ATN This is a function which returns the arc-tangent of its argument, usually in radians. It is widely available and is often the only inverse trig function available. Thus it is often used to return angles calculated via other trig functions using the standard trigonometrical conversions. It is in the ANSI minimim Basic vocabulary.

AUTO A command, not used in programs, which provides for automatic insertion of line numbers. It can usually be followed by two values the first indicating the start line number, and the second setting the increment value. On most micros both these values default to 10 if no values are entered.

B

BASE Although a word in the ANSI minimum Basic vocabulary, it is not often encountered on micro-computers. It is a statement which defines the lowest numbered variable array element. This is usually 0 to 1, but some compilers allow higher numbers. For instance:

```
10 BASE 10
20 DIM 15
```

will produce an array of six elements numbered 10 to 15. Most microcomputers have a fixed lowest array number of either 0 or 1.

BELL This is a statement from Apple II Basic which causes the computer's built-in speaker to produce a sound when it is encountered within a program.

BGET A BBC Basic extension function which takes a byte from the file whose channel number is the argument.

BPUT A BBC Basic extension function which places a byte in the file whose channel number is the first argument. This function passes the least significant byte of its second argument.

BREAK This is often a key command, but is found as a program statement in some Basics. When encountered, it stops the computer and places it in the monitor mode awaiting a command. It is thus similar to a STOP, but the program run can be continued with the direct command CO or CONT. When the BREAK statement is encountered the current values of all variables are retained, awaiting the command to continue the run sequence.

BYE A command used on the Atari and MZ-80K to close files and return to the operating system.

C

C. Used in TRS-80 Level I as an abbreviation for CONT. *See CONT*

CALL A statement used by some micros, including the BBC Micro and the Apple II, which causes the computer to leave Basic coding and execute a machine language routine, the argument being the address of the routine. It is similar to the statements USR(0) and LINK used by other machines.

CDBL A function which will change numbers, or numerical variables into double precision format. Usually to 17 significant figures of which 16 are printable.

CHAIN This is a statement, available on many micros, which allows a second and subsequent program to be loaded and run without nulling the values of the variables produced by the first program. On the BBC Micro this command nulls all variables except those whose second character is %. These are saved for use in the new program.

CHAR A function which returns the character represented by the ASCII decimal code number used as the argument.

CHAR$ A similar function to CHAR.

CHR A similar function to CHAR.

CHR$ A similar function to CHAR above. In many micros this function is used, in conjunction with numerically high or low arguments, to produce cursor control statements. *Your Computer* June and August 1982, page 43 gives more details.

CINT This function converts numbers or numeric variables into integer values. It differs from the INT function in that the original non-integer value is not lost and can be recalled later.

CLEAR This may be a command or a statement and has different uses on different machines. On some, such as the BBC Micro it clears all dynamically-declared variables, whilst on others, such as the TRS-80, it additionally sets up an area of reserved memory for string variables. It may also be used to clear terminal input or output buffers. Only careful consideration of the logic of the program can identify its intent, unless the dialect being used is familiar. ■

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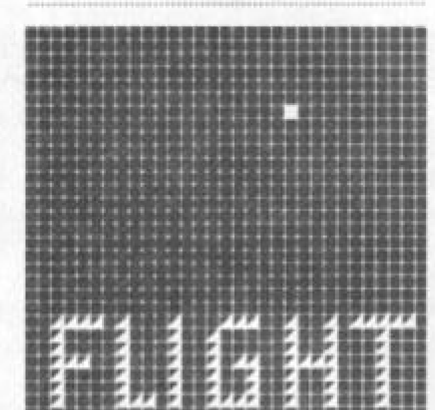


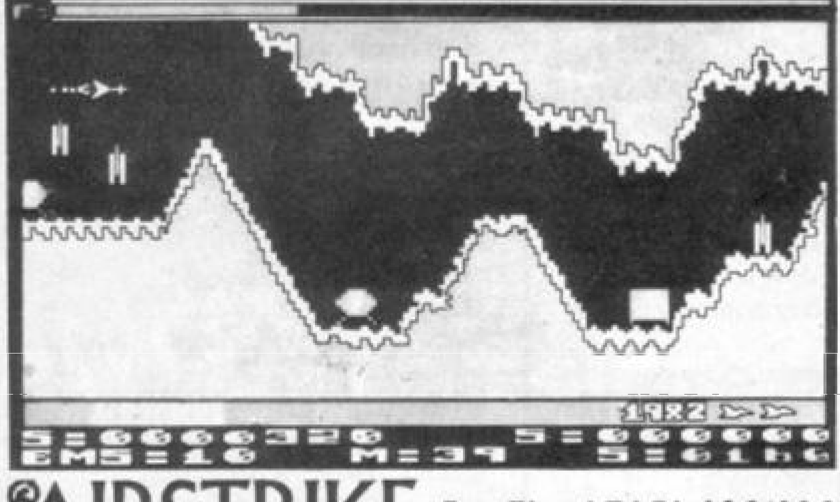
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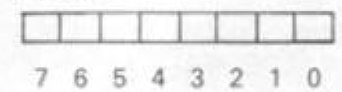
VIC BIG SCREEN

Space — the final frontier. Geoff Roberts shows you how to access more of the screen and boldly go where no Vic owner has gone before.



THE VIC 6561 chip has 16 control registers, all addressable, which control the display on the screen, the sound and the character set. Four of the registers are digital inputs for a light-pen and two joysticks.

The register we are looking at here controls the number of lines of characters that can appear on the screen. The address of this register is 36867 ($9003), and has the following format:



7 6 5 4 3 2 1 0

Bit numbers

Bits 1-6 are the number of lines or rows; bit 0 sets/resets double height characters, for use with high-resolution plotting; and bit 7 is part of the raster-scan line number.

The number-of-lines value starts at bit 1; this means that the values Poked into this register have to be double the number of extra lines required. Thus, if 25 lines are required, then 50 has to be Poked into this register.

If you Peek this register you will find the value 46 which is twice 23 — the usual number of lines. (Sometimes you will find the value 174 because bit 7 continually changes).

Try Poke 36867,60. The bottom part of the screen extends to reveal gibberish — there are now 30 lines on the screen. To re-centre this display, another register has to be altered. This is register 36865 ($9001) which sets the amount of border to be displayed at the top of the screen. Its normal value when Peeked is 38. For every line you have added to the display, reduce the contents of this register by two.

For example, we have just increased the screen by seven lines, so reduce the contents of 36865 by 14 to 24. Try Poke 36865,24. For most VDUs the display should now be centred again.

So, there are seven extra lines but the Basic operating system does not recognise them. The 6561 has extended the screen RAM by the necessary amount (in this case 7 × 22 = 154 bytes) but the operating system will not treat this extra memory area as part of the screen memory. What is this area anyway?

For Vics with 8K or less only the first six bytes of the extended memory actually exist and they are the left-overs of the screen memory; only 506 bytes out of 512 are used for the display.

For Vics with greater memory, this area is part of the Basic program area (apart from the first six bytes) and it is to these privileged Vics that the rest of the article refers.

The expanded part of the screen shows the contents of the Basic program area; the colour comes from the colour RAM, which the 6561 has also "expanded". The address of the beginning of these extra areas in the screen RAM and colour RAM are, respectively, Screen 4602 and Colour 38394.

One could Poke values into the screen and colour RAM to change the display. However, any Pokes into the extended screen area would corrupt the Basic program area. So, before this extended area can be used, the start of Basic has to be moved. The screen memory could be moved but this would unnecessarily restrict the Basic program area.

Let us first deal with the program area. Locations 44 and 43 together point to the start of Basic — they should currently contain 18 and 1. This means the program begins at 18*256+1 = 4609. The actual area begins at one less than this — 4608 — with the very first location containing zero. So to change the start of Basic and to keep the other pointers in the correct format use the following procedure:

```
POKE45,3: POKE46,20: POKE20*256,0:
POKE43,1: POKE44,20: NEW
```

The beginning of Basic is now at 20*256 = 5120.

You can now create or load any Basic programs as usual and the extra screen memory can be safely Poked into. However, Poking to the screen and colour RAM is not the quickest or easiest way of changing the screen display. Using Print, a whole line can be printed in one instruction, *and* the colour RAM is changed at the same time. The operating system can be "fooled" into Printing to the extended screen area by writing a program with, first, a subroutine positioning the cursor at the beginning of each line before printing on that line; and secondly, forbidding any carriage returns, vertical cursors, Tab or Spc functions to be used. The subroutine to position the cursor is as follows:

```
1000 POKE214,LN-1:POKE211,0
1010 A=4096+(LN-1)*22: MS=INT(A/256):
     LS=A-MS*256
1020 POKE210,MS: POKE209,LS
1030 RETURN
```

LN is the parameter used to select the line number required. For example, LN = 1: Gosub 1000 sets the cursor in the home position. LN = 30: Gosub 1000 in our case will set the cursor at the beginning of the very bottom line — a Print after these statements will print on that line. A Tab can be effected by Poking a value between 0 and 87 into 211. Note — to avoid trouble terminate each Print statement with a semicolon, so that a carriage return does not occur.

A useful routine using this subroutine clears the extended screen area.

```
2000 FOR LN=24TOLL
2010 GOSUB 1000: FOR I=1 to 21: PRINT " ";:
     NEXTI
2020 POKE A + 21,32: POKE37888+LN*22-1,1
2030 NEXT LN
2040 RETURN
```

LL is the number of the last line on the screen — in our case it should be replaced or set to 30. Line 2020 prints a space in the last column position on each line and is a precautionary measure to avoid a carriage return occurring.

If you are going to try these programs then remember to move the start of Basic first, as shown, and do not forget that you have moved it! This is one way to write a program that uses an extended screen, without having to move Basic everytime you load it. First, start with a fresh system, then create the following program:

```
10 POKE 44,20:RUN
```

Next, move the start of Basic — as previously shown — and create or load your main program. Do not Run it. Do Poke 44,18 — try a List. Save the program. You should now have a program that uses an extended screen which can be Loaded into the normal Basic area.

The examples in this article considered the new start of Basic to be 5120. The start of Basic can be moved almost anywhere — try replacing the value 20 in the move-Basic routine with different values; preferably greater than 18. ■



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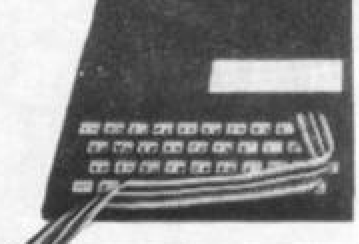
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GRAPHICS AND TEXT

Problems caused by mixing text and graphics on your Atom should be resolved by adopting Stephen Yewdall's approach. Text and graphics in any mode can be mixed on-screen without interfering with normal program running.

IT WAS WHILE developing a program for Fourier analysis using the Atom's high-resolution graphics that I realised the difficulty of mixing text and graphics.

An article in August *Your Computer* page 43 showed a way of displaying three lines of text with the rest of the screen showing graphics. However, this had one disadvantage: it locked the micro in a timing loop and stopped program execution.

My solution is to use the VIA T2 timer as an interrupt generator when the mode needs changing, so allowing it to run normally but with a speed reduction of up to one third. This program enables text and graphics in any Mode to be mixed on-screen. The format is three lines of text at the top of the screen, and Mode 4 graphics of 256 × 154 pixels.

The program is in machine code and takes 72 bytes of RAM. This may be reduced to just 42 bytes, if there are no other interrupt routines and initialisation is only needed once. The advantage of using interrupts in this way is that the micro's switching between text and graphics is transparent to the normal running program.

Lines 2300 to 3200 are the machine code instructions to initialise the timer, T2, enable its interrupt, and set a dummy time to get an interrupt.

Lines 3400 to 3800 are the interrupt service routine and determine if the T2 timer has interrupted. If it was not T2, then an indirect jump is made. This takes the address of the next instruction from 3BF5, but can easily be changed to suit. Note that if T2 is the only possible interrupt, these lines can be omitted.

Lines 4000 to 6000 generate the main machine-code routine. First the flyback point, that is when the TV beam returns to the top of the screen is determined: lines 4000 and 4020. Then the current mode and keyscan data is saved: lines 4040 and 4050. The VDU is set to text mode, lines 4060 and 4100. Then the VIA T2 timer is synched to the start of the new TV frame and set to give another interrupt.

Provided the count is less than 40E0, hex, interrupts are synched to the flyback, lines 4110 to 4160. Because the T2 is synched to the start of the new frame, by reading its count one can determine when to change the mode.

To be really accurate, both the high byte and low byte should be read to find the correct point, although by adjusting the interrupt count to suit, only the high byte needs to be to read, lines 5100 to 5300. Then the original mode and keyscan data are restored, lines 5500 and 5600 and normal operation is resumed until the next interrupt, lines 5700 to 5800. Lines 200 to 1900 are the Basic program that assembles the machine-code routines — lines 300 to 700 — sets the interrupt vector to the start of the compiled code — line 800 — and finally links to the initialisation part. Subroutine 8000 demonstrates how to clear the top three lines of the screen. The number of lines of text can be varied by changing the value of the compare statement on line 5200. One unexpected advantage of using this program is that the keyboard-scan routines take longer, hence the keyboard is less prone to bounce.

Software clock

A lot of time is spent by the micro checking that the T2 count is correct before switching modes. By inserting a short routine between the lines 4160 and 5100 better use is made of the micro's time.

For example, what about a clock for telling the time of day? Since the main routine is entered at 60Hz — flyback rate — it is relatively simple to generate an accurate software clock. It is also possible to generate a machine-code program as a substitute for subroutine 8000, and to include the setting of the interrupt vector in machine code before the initialisation routine of the T2 timer.

For demonstration purposes, type in and run the program. All should be normal. In direct mode type:

GOSUB 8000;

This positions the cursor at the top left of the screen and blanks three lines following the cursor. Next, type:

CLEAR 4

This sets the lower half of the screen to graphics mode 4, and leaves the cursor on the second line. It also fills the first three lines with "@"s. Type:

MOVE 0,0; DRAW 256,192:

Unfortunately, this is not the diagonal line expected. Due to the switching between modes the Y axis has changed and it is necessary to add an offset as shown in the table, as Y = 0 is off the bottom of the screen. Note also that some characters in the text lines have changed. This is due to the plot routines which expect the whole screen to be in graphics mode 4. The net result is that all subsequent plot statements must add an offset to the Y value and also limit its maximum value. Type:

CLEAR 4; GOSUB 8000;

then type:

MOVE 0, 33; DRAW 256,187;

This gives a diagonal line from bottom left to top right of the graphics screen. If you now type ESC you will be returned to normal mode 0 text. Thus it is possible to switch between normal mode and mixed graphics text easily. Should the Break key be accidentally pressed it will be necessary to reset the interrupt vector and initialise the timer, provided the machine code has been assembled to start at # 3BB0. Type:

? # 205 = # 3B; ? # 204 = # CI; LINK # 3BBO

```
300   DIM VV(10)
400   C = #3BB0
500   FOR I = 0 TO 10; VV(I) = C; NEXT I
600   P = C; GOSUB 2300
700   P = C; GOSUB 2300
800   ?#205 = VV1&#FFFF/256;?#204 = VV1
1000  LINK #3BB0
1900  END
2000  REM SET TIMER 2 AS ONE SHOT
2300  [
2500   VV0 LDA #B80B
2600       AND @#DF
2700       STA #B80B
2900       LDA @#A0
3000       STA #B80E
3100       STA #B809
3200       RTS
3400   VV1 LDA #B80D
3500       AND @#20
3600       BNE VV3
3800       JMP (VV6 + 1)
4000   VV3 BIT #B002
4020       BMI VV3
4040       LDA #B000
4050       PHA
4060       LDA @#00
4100       STA #B000
4110   VV5 BIT #B002
4120       BPL VV5
4130       LDA @#87
4140       STA #B808
4150       LDA @#40
4160       STA #B809
5100   VV4 LDA #B809
5200       CMP @#2E
5300       BCS VV4
5500       PLA
5600       STA #B000
5700       PLA
5800   VV6 RTI
5900  ]
6000  RETURN
8000  P.$30;Y = 95; LINK #FE24;RETURN
```

Program to mix text and graphics.

MODE	Y OFFSET	YMAX	RESOLUTION X	Y
0	0	38	64	48
1A	4	55	64	51
1	4	55	128	51
2A	9	60	128	51
2	10	87	128	77
3A	15	92	128	77
3	28	182	128	154
4A	33	187	128	154
4	33	187	256	154

Table of Y offsets — for three lines.

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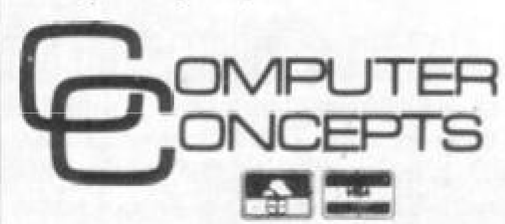
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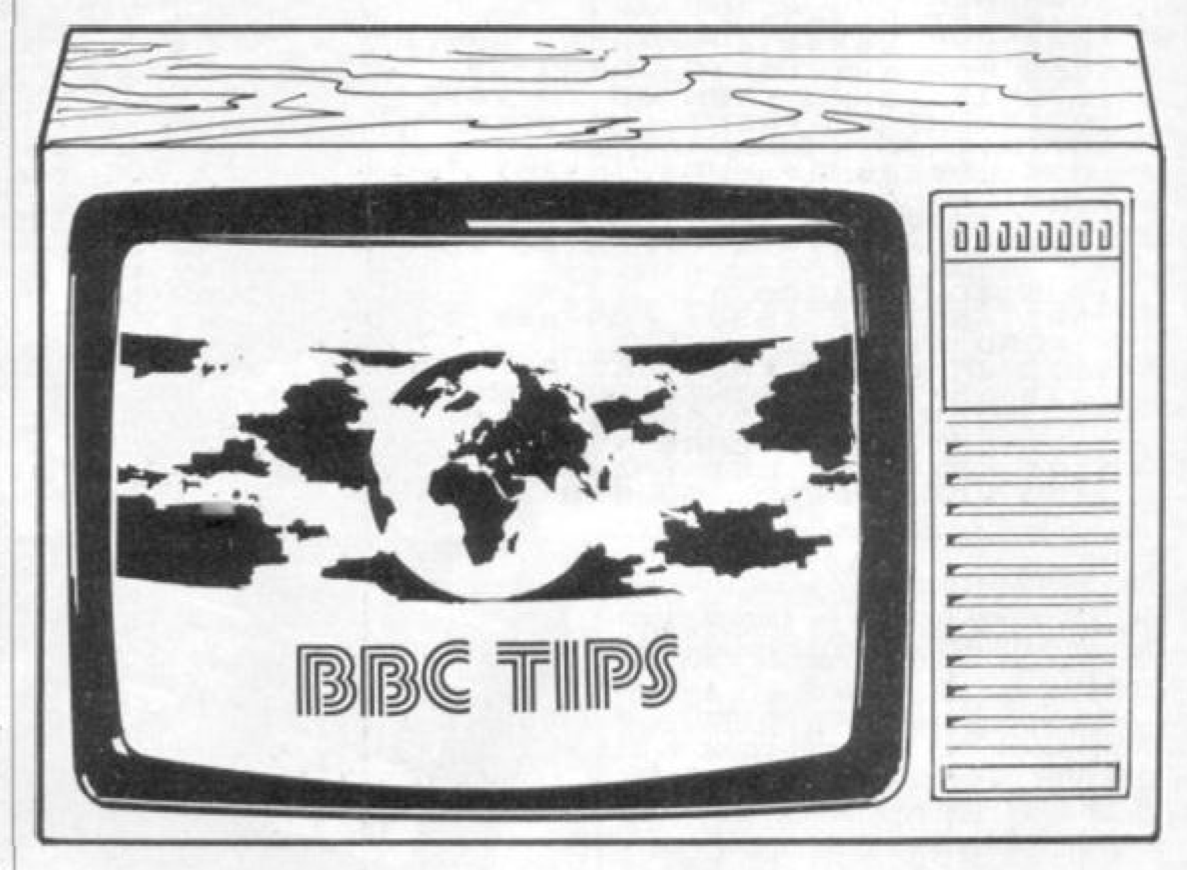
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CONTROL KEYS

Further operating wrinkles are revealed this month by *Your Computer's* own guide to the BBC Micro. Tim Langdell lifts the veil on control-key alternatives to the VDU commands which are not immediately apparent even in the new BBC manual. These should save you time and precious memory — but take care which keys you choose.



IF YOU HAVE explored the VDU commands on the BBC then you know how useful they can be. A particularly exciting feature of the machine is the ability of the CTRL key to duplicate these functions instantly. This can save a great deal of time compared to the equivalent VDU statement.

For a list of the CTRL possibilities, and corresponding VDU commands, see figure 1. In theory, pressing CTRL followed by any of the keys on the left above will cause the function on the right.

In practice, where the VDU statement takes several bytes after it, for example, VDU 19,1,4 0,0,0, the CTRL version does not produce readily predictable results.

Magenta screen

For instance, in Mode 4, try pressing CTRL with the S key followed by key D, and then CTRL S followed by key E. You will get a magenta screen with blue text. But quite probably the text will be blurred and the screen hazy. Pressing CTRL S lets you put in two bytes of information spaced by commas, as would a VDU command, but trying to enter CTRL S,1,2, does not give the same effect as VDU 19,1,2,0. CTRL T resumes the black and white text again.

Other CTRL commands may be even more useful though. For instance, CTRL B enables the printer, and CTRL C switches it off again. Using CTRL B can avoid the necessity of including the VDU 2 statement in your program.

CTRLs H, I, J, and K simply duplicate the cursor controls. CTRL L clears the whole screen in much the same way as the Clear key does on other computers.

A convenient function is performed by CTRL U. This deletes the line you have just typed in and puts you back at the start of the line again. CTRL M acts exactly like Return, so one must be careful when using Shifted M not to touch the CTRL key by mistake.

CTRL N turns the page mode on, and can thus be very useful when listing long programs. Simply use CTRL N followed by L and Enter. The listing will then occur a page at a time, moved on by pressing the SHIFT key. CTRL O switches the page mode off again.

Cursor return

CTRL^sends the cursor back to Home — the top left-hand corner of the screen) — and whereas CTRL L clears the screen and sends the cursor back to Home, CTRL P clears the screen and leaves the cursor wherever it was.

A final very helpful CTRL command is CTRL V. Pressing this followed by a number gives you that mode — which is easier than typing in Mode x followed by Enter, or even the shortened form MO. x followed by Enter.

More than once before becoming fully acquainted with the CTRL features I hit the A key by mistake when shifting a letter. This unintentionally sent the very next character to the printer. CTRL W is much less likely to be hit by mistake, but it can lead to the next key you press being replaced by a random character square of dots which the micro has taken to be your newly-defined character.

Defining colours

Sadly, one cannot define a character using CTRL W just as CTRL S and CTRL Q are hard to predict, too. In case you have been misled by the way the VDU commands are described in the user's guide, you can define any two colours in Mode 0. Using CTRL Q or CTRL S is not to be recommended, although new text and screen colours are obtained. But VDU 19 will allow you to choose any two colours — not just the default black and white some have taken the guide to imply. ■

CTRL	VDU	Function	CTRL	VDU	Function
@	=0	Does nothing	N	14	Page mode on
A	1	Sends next CHR$ to printer	O	15	Page mode off
B	2	Enable printer	P	16	Clear graphics area
C	3	Disable printer	Q	17	Define text colour
D	4	Write text at text cursor	R	18	Define graphics
E	5	Write text at graphic cursor	S	19	Define logical colour
F	6	Enable VDU drivers	T	20	Restores logical colours
G	7	Make a short beep	U	21	Disable VDU/Clear line
H	8	Backspace	V	22	Select screen mode
I	9	Forward space	W	23	Program a new character
J	10	Cursor down	X	24	Define graphics window
K	11	Cursor up	Y	25	Plot K,x,y
L	12	Clear text area	Z	26	Restore windows
M	13	Cursor to start of next line/return	/	28	Define text window
			]	29	Define graphics origin
			^	30	Home cursor

Figure 1.

```
1000 REM ZX Spectrum Assembler
 © Chris Lam
1001 LET add=30000: LET k$="Loop
 Finished "
1002 INPUT "# of lines?",bb: FOR
 j=0 TO bb
1004 RESTORE 2000+j
1005 LET x=0: LET v=0: LET v1=0:
 LET v2=0
1006 DIM d$(3): LET t=2: LET b=1
121
1007 READ a$: LET y=LEN a$: LET
p=1
1008 IF a$(1)="#" THEN GO TO 160
0
1009 RESTORE 1820
1010 GO SUB 1020: GO TO 1060
1020 IF p>y THEN GO TO 1400
1021 FOR n=p TO y
1025 IF a$(n)=" " OR A$(N)="," T
HEN GO TO 1040
1030 NEXT n
1040 LET p2=n-1
1050 LET x$=a$(p TO p2): RETURN
1060 FOR n=1 TO 43: READ r$
1070 IF r$=x$ THEN GO TO 1075
1071 NEXT n: PRINT "NO SUCH
COMMAND AT";2000+J:STOP
1075 LET d$(1)=CHR$ (n+46)
1080 LET p=p2+2: GO SUB 1020: GO
 SUB 1090: GO TO 1120
1090 IF x$(1)="(" THEN GO TO 130
0
1095 GO TO 1200
1101 RESTORE 1830: FOR n=1 TO 28
: READ r$
1110 IF r$=x$ THEN RETURN
1115 NEXT n: PRINT "NO SUCH
REGISTER ETC AT";2000+J:STOP
1120 LET d$(t)=CHR$ (60+n)
1121 LET t=3: LET b=1135
1130 LET p=p2+2: GO SUB 1020: GO
 SUB 1090: LET d$(t)=CHR$ (60+n)
1136 RESTORE 1800: FOR n=0 TO 25
5: READ r$
1140 IF r$=d$ THEN GO TO 1150
1145 NEXT n: PRINT "NO SUCH
REGISTER ETC AT";2000+J:STOP
1150 POKE add,n
1155 IF x=1 THEN GO TO 1190
1160 IF x=2 THEN GO TO 1195
1170 LET add=add+1: NEXT j: PRIN
T k$: STOP
1190 POKE add+1,v1: LET add=add+
2: NEXT j: PRINT k$: STOP
1195 POKE add+1,v1: POKE add+2,v
2: LET add=add+3: NEXT j: PRINT
k$: STOP
1200 IF CODE x$(1)<58 THEN GO TO
 1215
1210 GO TO 1100
1215 LET v=VAL x$
1220 IF d$(1)="F" OR d$(1)="H" T
HEN GO TO 1235
1221 IF d$(2)="@" OR d$(2)="A" O
R d$(2)="B" OR d$(2)="M" THEN GO
 TO 1235
1225 IF v>=256 THEN GO TO 1235
1228 LET d$(t)="L"
1229 IF d$(1)=":" OR d$(1)="I" T
HEN LET d$(t)="S"
1230 LET v1=v: LET x=1: GO TO b
1235 GO SUB 1240: GO TO b
1240 LET d$(t)="D"
1241 LET v2=INT (v/256)
1242 LET v1=v-(v2*256)
1245 LET x=2: RETURN
1300 REM
1310 IF CODE x$(2)<58 THEN GO TO
 1330
1320 GO TO 1100
1330 LET v=VAL x$: LET d$(t)="W"
: GO SUB 1241
1340 GO TO b
```

THIS PROGRAM assembles Z-80 machine code. All Z-80 mnemonics can be entered except those after CB, ED or those that include index registers.

Lines 1800 to 1805 may be entered, as shown. Check each line before typing in the next. After that, type in lines 1820 and 1830. Check again and type in the rest of the program. All that is shown in capitals must be typed in capitals.

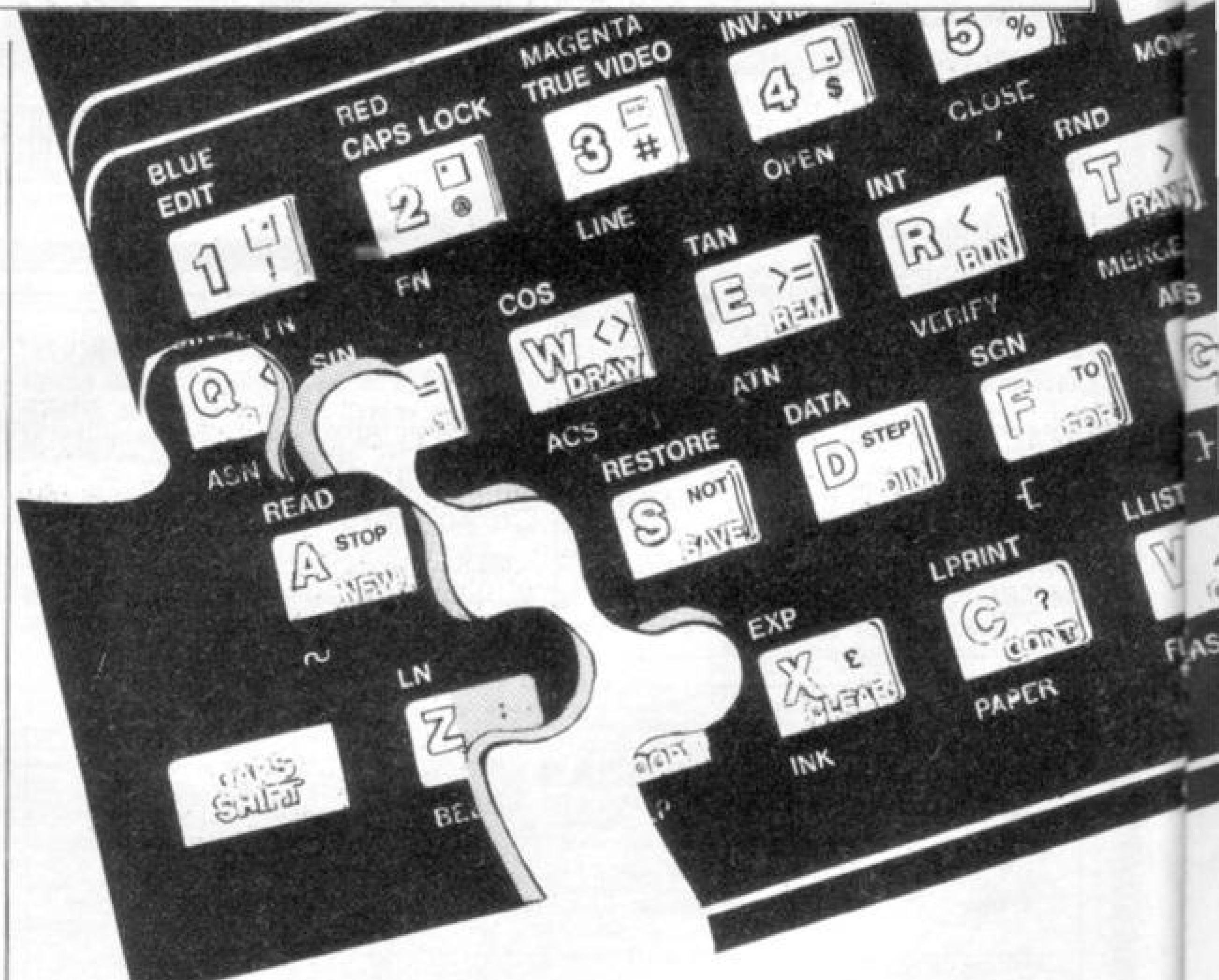
The program takes the mnemonics which start at line 2000 and converts them to three characters. This is compared against each string from the data at lines 1800 to 1805. The number of strings it had to read off against before finding a match is the Z-80 Op-code for that mnemonic.

Take a look at lines 1820 and 1830. Line 1820 contains the commands which you can enter. Note that all the RST commands are in decimal. Line 1830 are all the registers you can enter. "NN", "N", "(NN)" and "DS" are there solely to help the computer.

All your Z-80 mnemonics must start at line 2000. Each line after that must be incremented by one. See line 1004: the mnemonics must be in quotes and entered as a DATA statement. Only one mnemonic a line is permitted. Therefore type this in:

```
2000 DATA "LD BC,65535"
2001 DATA "RET"
```

and Run the program. It will ask you how many lines of mnemonics there are. In this case, type in 2. Wait a few seconds and a message "Out of DATA" should appear. These 4 bytes of code have been entered into the memory starting at the address 30000. This can easily be changed to any address at line 1001. Run 3000 and you shuld get 1, 255, 255, 201.

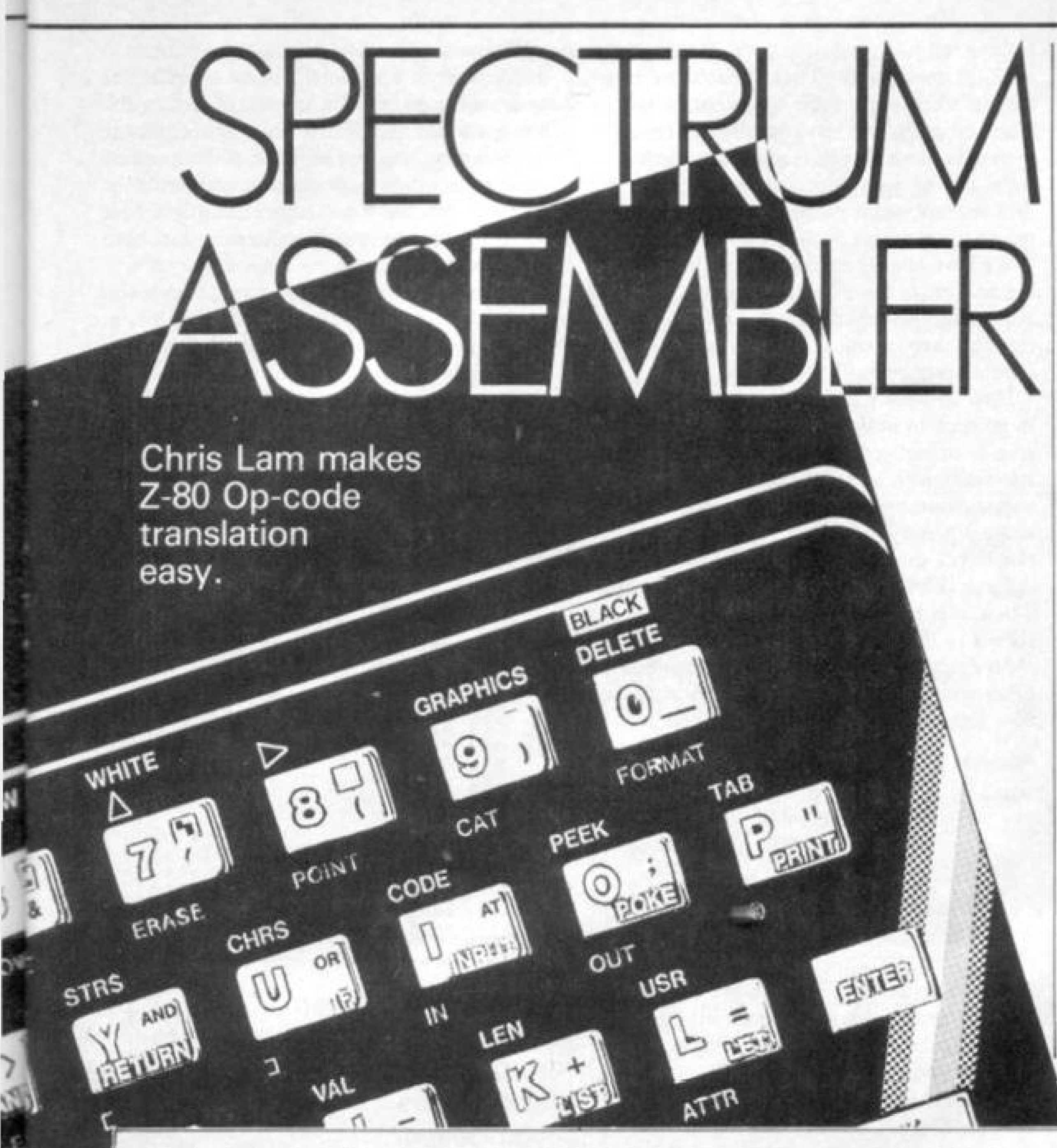


Now if you have enough confidence, type PRINT USR 30000 and you should get 65535. There are however some very important points on how you must enter your machine code program.

- There must be no spaces between the 1st quote and the 1st letter of the mnemonic.
- There must be only one space between the command and the next part, register or number. For example "LD (65535),a" is allowed while "LD (65534), a" is not. The same applies to the first register or number and second register or number, but it may be a comma, for example "LD A,B" is OK and "LD A B" is OK. See line 1025.
- There should be no spaces at the end.

SPECTRUM ASSEMBLER

Chris Lam makes Z-80 Op-code translation easy.



■ Enter mnemonics for Op-codes: 211 and 219 without the brackets.

■ You can have negative displacements. For example, "DJNZ -3" is the same as "DJNZ 253" and both are allowed. Do not forget that "JR 0" jumps to the following byte. As mentioned before, mnemonics that have CB, ED or IX or IY, must be written in hexadecimal prefixed by a hash. Therefore you can write:

```
2000 DATA "# ED4BFF": REM LD BC, (65535)
```

See line 1008

Type in this demonstration program.

```
2000 DATA "LD HL,0"
2001 DATA "LD BC,100"
2002 DATA "ADD HL BC"
2003 DATA "DEC BC"
2004 DATA "JR NZ  -4"
2005 DATA "PUSH HL"
2006 DATA "POP BC"
2007 DATA "RET"
```

This could easily be shorter but is lengthened to show how well this assembler can handle the mnemonics. Run the program and type in 7 to the prompt — despite the fact it has eight lines — and ENTER. It takes the computer two to five seconds to assemble one line of mnemonic, so this will take 20 to 30 seconds.

Finally it should display "Loop Finished" (see line 1002 and 1004). Now if you are still doubtful, Run 3000 first and check it. Then enter PRINT USR 30000 and the reply should be 5050. For those who haven't a clue why this printed, the machine code program calculates the total of all the numbers from 1 to 100 added together.

Now type in CLEAR 30000 and follow it with NEW. Again type in PRINT 30000 and you should get 5050 again. So now you have a machine-code program, safe above RAMtop.

```
1400 LET d$(t)="7": GO TO b
1600 LET a$=a$(2 TO )
1610 FOR n=1 TO LEN a$ STEP 2
1620 LET x$=a$(n TO n+1)
1621 LET x=CODE x$(1)-48: IF COD
E x$(1)>64 THEN LET x=x-7
1622 LET y=CODE x$(2)-48: IF COD
E x$(2)>64 THEN LET y=y-7
1630 LET v=16*x+y
1640 POKE add+INT (n/2),v
1645 NEXT n: LET add=add+INT (n/
2): NEXT j
1800 DATA "U77","7BD","77E","8B7
","8J7","9J7","7JL","/77","VCC",
"D@B","7E7","9B7","8K7","9K7","7
XL","077",";S7","7AD","7>E","8A7
","8H7","9H7","7HL","177","IS7",
"D@A","7E>","9A7","8I7","9I7","7
IL","377","INS","7@D","7W@","8@7
","8F7","9F7","7FL","277","IOS",
"D@@","7@W"
1801 DATA "9@7","8G7","9G7","7GL
","X77","IPS","7MD","7WE","8M7",
"8=7","9=7","7=L","477","IQS","D
=M","7EU","9M7","8E7","9E7","7EL
","577","7JJ","7JK","7JH","7JI",
"7JF","7JG","7J=","7JE","7KJ","7
KK","7KH","7KI","7KF","7KG","7K=
","7KE","7HG","7HK","7HH","7HI",
"7HF","7HG"
1802 DATA "7H=","7HE","7IJ","7IK
","7IH","7II","7IF","7IG","7I=",
"7IE","7FJ","7FK","7FH","7FI","7
FF","7FG","7F=","7FE","7GJ","7GK
","7GH","7GI","7GF","7GG","7G=",
"7GE","7=J","7=K","7=H","7=I","7
=F","7=G",";77","7=E","7EJ","7EK
","7EH","7EI","7EF","7EG","7E=",
"7EE","DEJ"
1803 DATA "DEK","DEH","DEI","DEF
","DEG","DE=","DEE","QEJ","QEK",
"QEH","QEI","QEF","QEG","QE=","Q
EE","OJ7","OK7","OH7","OI7","OF7
","OG7","O=7","OE7","NEJ","NEK",
"NEH","NEI","NEF","NEG","NE=","N
EE","EJ7","EK7","EH7","EI7","EF7
","EG7","E=7","EE7","PJ7","PK7",
"PH7","PI7"
1804 DATA "PF7","PG7","P=7","PE7
","JJ7","JK7","JH7","JI7","JF7",
"JG7","J=7","JE7","GJ7","GK7","G
H7","GI7","GF7","GG7","G=7","GE7
","MN7","KB7","HND","HD7","FND",
"LB7","DEL","<77","MO7","M77","H
OD","787","FOD","FD7","QEL","=77
","MP7","KA7","HPD","SLE","FPD",
"LA7","O7L"
1805 DATA ">77","MQ7","T77","HQD
","REL","FQD","797","NEL","?77",
"MR7","K@7","HRD","VU@","FRD","L
@7","EL7","@77","MX7","H=7","7XD
","VA@","FXD","7;7","PL7","A77",
"MT7","KC7","HTD","677","FTD","L
C7","JL7","B77","MU7","7M@","HUD
","W77","FUD","797","GL7","C77"
1820 DATA "RLCA","RRCA","RLA","D
RA","RRA","SCF","CCF","DI","LD",
"INC","DEC","DJNZ","HALT","RST0"
,"RST8","RST16","RST24","RST32",
"RST40","RST48","RST56","ADD","A
ND","CALL","CP","JP","JR","OR","
POP","PUSH","RET","SBC","SUB","X
OR","ADC","IN","OUT","EXX","NOP"
,"EX","EI","CPL"
1830 DATA "(HL)","(DE)","(BC)","
HL","DE","BC","AF","NN","A","H",
"L","D","E","B","C","N","SP","NZ
","Z","NC","C","PO","DS","P","M"
,"(SP)","(NN)","PE"
1999 REM Your Z-80 Data Starts
 Here
3000 FOR n=30000 TO 30010: PRINT
 PEEK n: NEXT n
```

■

```
   1 REM 5£RND????5 :?????0 70 70
 70 70 70 70 70 70 70 ; ,0 ,0 ,0 ;
 0 ,0 ?????;0 ,0 ,0 ,0 ,0 70 70 70
 70 70 70 70 70 TAN 0123456789 01234
5678901234567890123456789012345 6
7890
 200 CLS
 210 SLOW
 220 FOR K=2 TO 7
 230 PRINT AT K,8;"*"
 240 NEXT K
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

Program 5

Display of program 5

```
   1 REM 5£RND????5 ; FAST 0 7
 0 ( CLS 70 ) ,0 ( CLS ;0 LPR
INT ,0 ( CLS ;0 70 ( CLS TAN
 67890123456789012345678901234 56
7890123456789012345678901234567 8
9012345678901234567890123456789 0
   2 REM
 200 CLS
 210 SLOW
 220 FOR K=2 TO 7
 230 PRINT AT K,8;"*"
 240 NEXT K
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

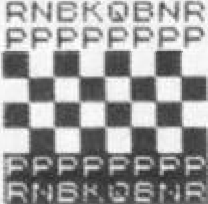
Program 5a

```
   1 REM E£RND) ; FAST 0 7
 0 ( CLS 70 ) ,0 ( CLS ;0 LPR
INT ,0 ( CLS ;0 70 ( CLS TAN
 67890123456789012345678901234 56
7890123456789012345678901234567 8
9012345678901234567890123456789 0
   2 REM
 200 CLS
 210 SLOW
 220 FOR K=2 TO 7
 230 PRINT AT K,8;"*"
 240 NEXT K
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

Program 5b

```
   1 REM Y
1538 AT ( CLS :Y VAL NOT AT (
CLS Y
 200 CLS
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

Program 7



Display of program 7

Note: REM 1 is given as display on your screen, it is significantly longer.

SO FAR WE have looked at 19 different groups of Z-80 commands. These enable us to do simple maths and a bit of instant graphics. The next stage is to show you how to reach the system variable. If you read the list starting on page 177 of your Sinclair Manual, you will find several useful pieces of information — if only you could get at them.

We have already used D-File which contains the address of the display file's start. There is also an address which contains information on the last key pressed, another containing a random number and so on.

How do we get at them efficiently? We have to go back to indirect addressing. As we have seen in an earlier part of this series, an indirect statement with a pair of variables can be used to put a number or any single variable into an address given by the pair of variables HL, or else to put the contents of an address given by the pair of variables HL into a single variable. These can be extended to include the codes shown in Figure 1.

An example would be a further simplification of program 5. Reload version 5A and Run 800. Enter the following machine code:

Address	Mnemonic		Machine Code
16514	LD	HL (NN)	42 12 64
	LD	DE NN	17 3 0
	ADD	HL DE	25
	PUSH	HL	229
	NOP		0
	NOP		0
	NOP		0
			R

Save as version 5B. This shows a saving in program length that could make all the difference between getting a program into 1K and having to abandon a good idea.

The next instruction — we cannot call it a command — is Code 215 (RST 16). This will print a character at the next print position.

Load program 1, see *Your Computer* August, Enter in program 6 and Run. Change the values of B and C to alter the box size. If you understand how it is working, enter program 6A and Run. Now change the item being printed to spaces. Move the box up and down and change the width.

We can delete lines 2, 200, 800, 801, 810, 820, 830, 840, 850. This will give a better idea of the size and speed of a machine-code program needed to fill out the display. You will notice that I am no longer spelling out in fine detail how every stage of each program works.

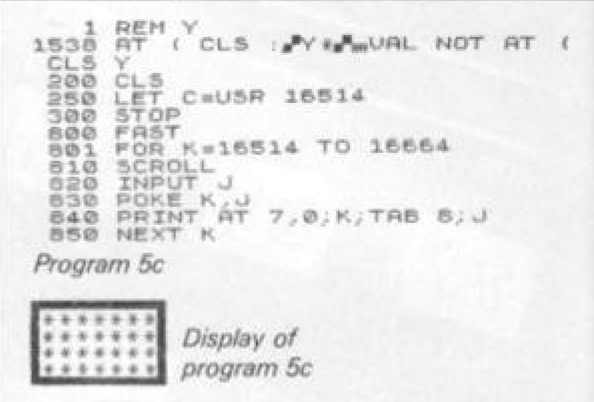
You should be able to see blocks of previously-defined code coupled with new commands and be able to work out for yourself precisely what is happening — if not, you should re-read the previous sections.

We can now produce our final simplification to program 5. This entails using the machine code routine to produce any size of rectangular box (program 5C). There are ways of passing the box size from one segment of the machine code to another such that it need only be entered once, but it will not necessarily reduce the program size and has therefore not been included.

The original program 5 is given, which also needed the Basic display-creating routine, as well as the final program 5C which creates its own display file.

There is one other type of gaming board that

SYSTEM



```
   1 REM Y
1538 AT ( CLS :Y VAL NOT AT (
CLS Y
 200 CLS
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

Program 5c

Display of program 5c

Part 3 of Kathleen Peel's introduction to machine code takes you deeper.




```
   1 REM :Y VAL NOT AT ( CLS
Y
 200 CLS
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

Program 6

```
********
********
********
********
********
********
********
********
********
```

Display of program 6

```
   1 REM 1234567890123456789012 3
4567890123456789012345678901234 5
6789012345678901234567890123456 7
8901234567890123456789012345678 9
0123456789012345678901234567890
   2 REM
 200 CLS
 210 SLOW
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

Program 1, above, and program 1a, right.

is used and we can look at a method of implementing that — the chess/draughts board.

A technique is required that will plot a table of characters in sequence on the display. Try to print RNBKQBNR, using program 7; this will produce such a display.

The code has been separated into small blocks such that after entering the program code and saving, we can see the effect of each section-type.

```
POKE    16568,201
RUN

POKE    16568,6
POKE    16576,201
RUN

POKE    16576,6
POKE    16590,201
RUN

POKE    16590,35
POKE    16599,201
RUN

POKE    16599,35
RUN
```

The display is produced by a total of 101 bytes of machine code — from address 16514 to 16614 — and the Basic program 1c.

A full list of the machine code used in this introduction is given in Figure 2. The definitions given are, of necessity, a simplification and in some cases a distortion of the truth as far as the Z-80 processor is concerned, but if you are able to write your own machine-code routines based on what you have read here, then the approach will be vindicated.

As you are probably well aware, there are many more commands which I have omitted to define. What will be of significant interest is the level of programs that can be achieved with this limited subset. *Your Computer* will provide a free copy of D R Horne's 1K chess-playing game on cassette, plus the usual rates for any of your routines that we are able to publish, based on this series of articles.

(continued on page 73)

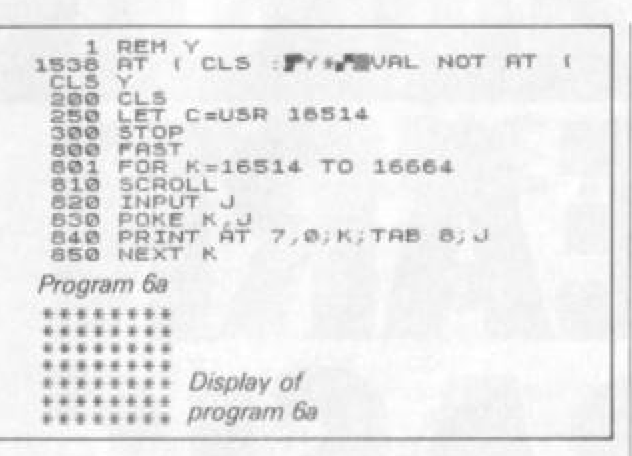
VARIABLES

Code	Mnemonic	Basic equivalent	Comments
50	LD (NN) A	POKE NN, A	Put into address NN the variable A
34	LD (NN) HL	POKE NN, H POKE NN + 1, L	Put into address NN the variable H and put into the next address variable L
58	LD A (NN)	LET A = PEEK NN	Load A with the contents of address NN
42	LD HL (NN)	LET H = PEEK NN & LET L = PEEK NN+1	load H with the contents of address NN and Load L with the contents of the next address.
26	LD A (DE)	LET A = PEEK DE	Load A with the contents of address DE
18	LD (DE) A	POKE DE, A	Put into address DE the variable A.

Figure 1

Code	Mnemonic	Basic equivalent
201	RETURN	
0	NOP	
24	JR DIS	
40	JR Z DIS	
32	JR NZ DIS	
16	DJNZ DIS	
245	PUSH AF	
197	PUSH BC	
213	PUSH DE	
229	PUSH HL	
241	POP AF	
193	POP BC	
209	POP DE	
225	POP HL	
50	LD (NN) A	POKE NN, A
34	LD (NN) HL	
58	LD A (NN)	LET A = PEEK NN
42	LD HL (NN)	
215	RST 16	
26	LD A (DE)	LET A = PEEK DE
18	LD (DE) A	POKE DE, A

Figure 2



```
   1 REM Y
1538 AT ( CLS :▛Y▖▞▆VAL NOT AT (
 CLS Y
 200 CLS
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

Program 6a

```
********
********
********
********
********
********
********
```

Display of program 6a



This instalment tells you how to get at the system variables.

```
   1 REM 12345678901234567890123
45678901234567890123456789012345
67890123456789012345678901234567
89012345678901234567890123456789
0123456789012345678901234567890
   2 REM ▓▓
 200 CLS
 210 SLOW
 220 FOR K=2 TO 7
 230 PRINT AT K,0;"*"
 240 NEXT K
 250 LET C=USR 16514
 300 STOP
 800 FAST
 801 FOR K=16514 TO 16664
 810 SCROLL
 820 INPUT J
 830 POKE K,J
 840 PRINT AT 7,0;K;TAB 8;J
 850 NEXT K
```

Address	Mnemonic	Machine code
16514	LD HL NN	33 12 64
	LD E (HL)	94
	INC HL	35
	LD D (HL)	86
	LD HL NN	33 3 0
	ADD HL DE	25
	LD A L	125
	LD C A	79
	LD A H	124
	LD B A	71
16528	LD (HL) N	54 135
	INC HL	35
	LD (HL) N	54 131
	INC HL	35
	LD (HL) N	54 131
	INC HL	35
	LD (HL) N	54 131
	INC HL	35
	LD (HL) N	54 131
	INC HL	35
	LD (HL) N	54 131
	INC HL	35
	LD (HL) N	54 131
	INC HL	35
	LD (HL) N	54 131
	INC HL	35
	LD (HL) N	54 4
16555	LD DE NN	17 10 0
	ADD HL DE	25
	LD (HL) N	54 5
	ADD HL DE	25
	LD (HL) N	54 5
	ADD HL DE	25
	LD (HL) N	54 5
	ADD HL DE	25
	LD (HL) N	54 5
	ADD HL DE	25
	LD (HL) N	54 1
16572	LD A C	121
	LD L A	111
	LD A B	120
	LD H A	103
	ADD HL DE	25
	LD (HL) N	54 133
	ADD HL DE	25
	LD (HL) N	54 133
	ADD HL DE	25
	LD (HL) N	54 133
	ADD HL DE	25
	LD (HL) N	54 133
	ADD HL DE	25
	LD (HL) N	54 2
16591	INC HL	35
	LD (HL) N	54 3
	INC HL	35
	LD (HL) N	54 3
	INC HL	35
	LD (HL) N	54 3
	INC HL	35
	LD (HL) N	54 3
	INC HL	35
	LD (HL) N	54 3
	INC HL	35
	LD (HL) N	54 3
	INC HL	35
	LD (HL) N	54 3
	RET	201

99 Bytes

Program 5

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(continued from page 69)

Address	Mnemonic	Machine code	Comments
16514	LD A N	62 118	Create blank display
	LD B N	6 2	
	PUSH BC	197	
	RST 16	215	
	POP BC	193	
	DJNZ DIS	16 251	
	LD C N	14 6	No of rows across
	LD A N	62 0	
	LD B N	6 9	No of columns down
	PUSH BC	197	
	RST 16	215	
	POP BC	193	
	DJNZ DIS	16 251	
	LD A N	62 118	
	RST 16	215	
	DEC C	13	
	JP NZ DIS	32 241	
16540	LD HL (NN)	42 12 64	Start of display file
	LD DE NN	17 3 0	
	ADD HL DE	25	
	PUSH HL	229	
16548	LD (HL) N	54 135	
	LD B N	6 7	no of steps across
	INC HL	35	
	LD (HL) N	54 131	
	DJNZ DIS	16 251	
	INC HL	35	
	LD (HL) N	54 4	
16560	LD DE NN	17 10 0	
	LD B N	6 4	no of steps down
	ADD HL DE	25	
	LD (HL) N	54 5	
	DJNZ DIS	16 251	
	ADD HL DE	25	
	LD (HL) N	54 1	
16573	POP HL	225	
	LD B N	6 4	no of steps down
	ADD HL DE	25	
	LD (HL) N	54 133	
	DJNZ DIS	16 251	
	ADD HL DE	25	
	LD (HL) N	54 2	
16584	LD B N	6 7	no of steps across
	INC HL	35	
	LD (HL) N	54 3	
	DJNZ DIS	16 251	
	RET	201	

78 Bytes

Program 5c

Address	Machine code	Mnemonic	Comments
16514	14 9	LD C N	No of rows across
	62 23	LD A N	Character printed
	6 8	LD B N	No of columns down
	197	PUSH BC	Save BC (It is altered by RST 16)
	215	RST 16	Print character A
	193	POP BC	Recover BC
	16 251	DJNZ DIS	Decrease column count
	62 118	LD A N	Enter end of line
	215	RST 16	Print end of line
	13	DEC C	Decrease row count
	32 241	JP NZ DIS	Finished no-loop
	201	RET	Return

Program 6

Address	Machine code	Mnemonic	Comments
16514	62 118	LD A N	)
	6 2	LD B N	)
	197	PUSH BC	) Step down B lines
	215	RST 16	) before commencing
	193	POP BC	)
	16 251	DJNZ DIS	)
16523	14 7	LD C N	No of rows across
	62 23	LD A N	Character to be printed
	6 8	LD B N	No of columns down
	197	PUSH BC	Save BC (It is altered by RST 16)
	215	RST 16	Print character A
	193	POP BC	Recover BC
	16 251	DJNZ DIS	Decrease column count
	62 118	LD A N	Enter end of line
	215	RST 16	Print end of line
	13	DEC C	Decrease row count
	32 241	JP NZ DIS	Finished no-loop
	201	RET	Return

Program 6A

Address	Mnemonic	Machine code	Comments
16514	LD A N	62 118	Set up display file
	LD B N	6 2	
	PUSH BC	197	
	RST 16	215	
	POP BC	193	
	DJNZ DIS	16 251	
	LD C N	14 8	) Eight by eight empty
	LD A N	62 0	) display file
	LD B N	6 8	)
	PUSH BC	197	
	RST 16	215	
	POP BC	193	
	DJNZ DIS	16 251	
	LD A N	62 118	
	RST 16	215	
	DEC C	13	
	JP NZ DIS	32 241	
16547	JP DIS	24 8	Jump over table
16549		55 51 39 48	) Table of pieces
		54 39 51 55	)
	LD B N	6 8	Set up loop count
	LD DE NN	17 165 64	(16549) start of table
	LD A (DE)	26	Get contents of table
	LD (HL) A	119	and put into display
	INC HL	35	Next display position
	INC DE	19	next table position
	DJNZ DIS	16 250	Finished — no loop
16568	LD B N	6 8	Enter eight Ps
	LD A N	62 53	
	INC HL	35	
	LD (HL) A	119	
	DJNZ DIS	16 252	
16576	LD B N	6 18	Enter black and white squares
	LD C N	14 118	
	INC HL	35	
	INC HL	35	
	LD A (HL)	126	) Ensure we do not
	SUB C	145	) overwrite end of line
	JP Z DIS	40 2	) marker
	LD (HL) N	54 128	
	DJNZ DIS	16 246	
16590	INC HL	35	Enter eight black Ps
	LD B N	6 8	
	LD A N	62 181	
	NC HL	35	
	LD (HL) A	119	
	DJNZ DIS	16 252	
16599	INC HL	35	Enter black pieces
	LD C N	14 128	
	LD B N	6 8	
	LD DE NN	17 165 64	
	LD A (DE)	26	
	ADD C	129	Change white pieces to black
	INC HL	35	
	LD (HL) A	119	
	INC DE	19	
	DJNZ DIS	16 249	
	RET	201	

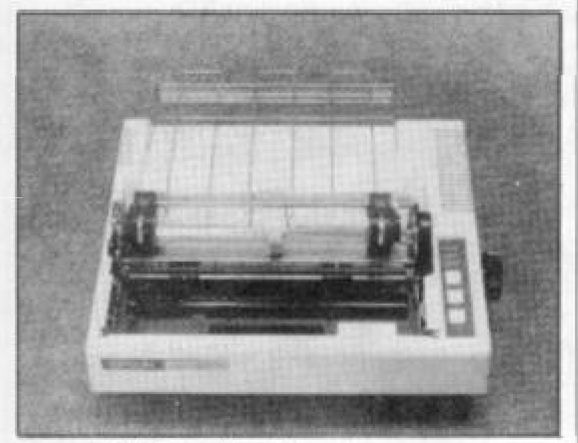
Program 7.

■

PICKING A

Buying the right machine in the first place is probably the most difficult part of computing. John Dawson offers some timely advice.

CHOOSING A COMPUTER necessitates systems analysis. Real computers only come into the process at the end, however, because the first thing you must do is to think about the job that a theoretical computer is intended for. It should be clear that if someone wants a computer for writing books, the machine will have to have a printer for producing draft copies of each chapter as the author works. Other requirements are more subtle but their effect may be just as disastrous if you miscalculate.



Epson's MX-80 offers 80cps.

Probably the most important consideration when you start to look at serious uses for small computers is maintenance. What happens when the computer goes wrong? I know at least two organisations that run their records in parallel — once on a computer system and once using a handwritten, manual backup. That is not only inefficient, it denies the very purpose of the original computer installation. If you are going to trust a machine with information that matters then the machine must be trustworthy.

Maintenance considerations

Maintenance does matter on relatively expensive machines such as the BBC Micro and the Sharp MZ-80 range and it is also important in relation to the timescale of the operation. For example, if you have an application that requires the use of the computer once a month then, on average, a fault in the system will probably not stop or inconvenience the operation if it is corrected within two weeks. If, on the other hand, you need your computer all day for on-line record keeping, you need a maintenance contract that guarantees repair within half a working day. The only difference is in the price — you might reasonably expect to pay 12 percent of the original price of the computer system each year for a maintenance contract that promised repair within one working day and two or three percent less for a contract based on a longer repair time span.

Do you need a maintenance contract at all? It might be better to chance a major fault and reckon to buy another computer, or tape recorder, or printer, if one part of the system goes wrong. This is particularly likely to be true when you are dealing with a very cheap system such as the Sinclair ZX-81 or Spectrum.

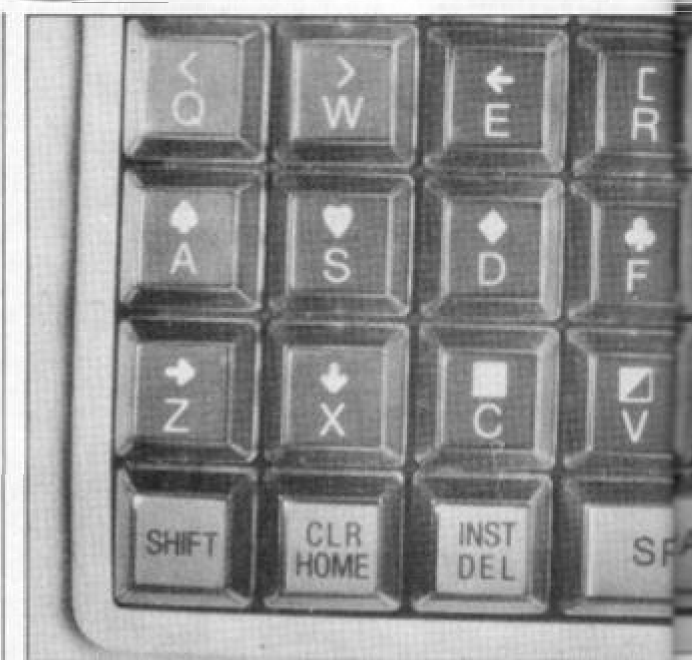
The second area to look at is size and speed. A Texas TI-58 calculator has more memory and operates faster than an IBM 650 mainframe from the 1950s; even so there are some jobs that will take too long to do on a Sinclair Spectrum or Acorn Atom. If you want to keep a file of records in the computer memory it is a simple matter to see whether they will all fit in at once, or whether you will have to load one section of the records, extract the information you require, then load a second set.

Access to records

Medical records are a good example; a typical system will allow 150 characters for the name and address, and about 50 characters for the NHS number, age and sex of the patient, medical facts about vaccination status and contraceptive advice that the GP may have given. A further 50 characters may be taken up with abbreviated details of the most recent illness, previous episodes of disease being recorded using seven-figure codes. Each record is allowed 250 characters. If there are 2500 patients in the practice it is clear that a theoretical computer system must be able to access at least 625,000 characters if the doctor wants to keep that sort of record.

The time in which the doctor requires access to a patient's record is also important. One medical system that ran on a Pet computer held about 250 characters of data about each patient on cassette tape. The system was used for repeat prescribing and the computer worked its way through the tape picking out the patients who had asked for more medicine. When it found the correct person the machine updated the record on another tape and printed a prescription. That took most of an afternoon, but it didn't matter because the system was designed that way and nobody expected it to do anything else while it was working.

Once you have arrived at some idea of the size and speed of machine you require, you might move on to think about the physical layout of the computer. Will the computer operator need to type in large quantities of information, or only small quantities of data? In other words, what is the balance between data entry and "computation"?





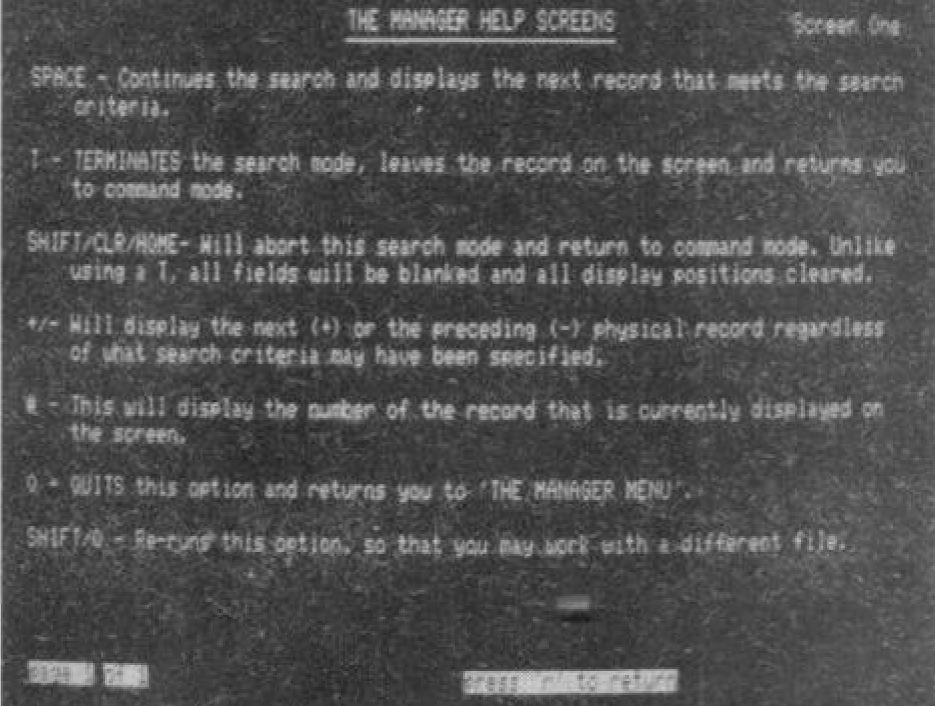
MZ-80 keyboard (above) is unsuitable for word processing. The Vic-20 (below) has typewriter keyboard but lacks serious software.

Type of task

A word processor is an example of very large data entry with minimal computing while the design of a boat hull may need only a small amount of information while involving a great deal of computer time. In the second case the keyboard design is relatively unimportant and a machine like the Sharp MZ-80K can do very well. However, the unorthodox keyboard on the Sharp makes it impossible for a touch typist to use and the machine is unsuitable,

MICRO





Will the screen display be uncomfortable on the eyes — and will you need a complete system? Will the peripherals suit the conditions of your task?





consequently, for use as a commercial word processor.

What about the visual display unit (VDU)? The ergonomics, or human factors engineering, of the display are important if the machine is to be used by one operator for long periods. Some of the early radar screens in the Second World War produced eye strain and styes among the operators and modern VDUs are still capable of precipitating visual instability, headaches and discomfort among long term operators. Amber displays are said to be the most relaxing to look at with green running a close second. Wobble and jitter in the display and the character design (true lower case descenders, legibility) are all important features for you to consider if the machine is to be used successfully by other people who may not have your degree of motivation.

Will cassette tapes be adequate for storing the records or documents produced on the machine? Most people think word processors can only be successful if they have floppy disc drives. As usual, it actually depends on what sort of word processing is to be done on the computer. If the machine is put into an office where the operator will spend most of the time composing standard letters by calling up paragraphs from a large selection then you need floppy or hard discs. If, on the other hand, the word processor is for a journalist or author who will work on one piece of text at a time then cassette tapes are entirely acceptable as a storage medium, provided that the whole of the article or a chapter can be held in the computer memory at once.

What sort of printer will the user require? Dot matrix printers work by firing needles at the typewriter ribbon and they produce a slightly ragged outline to each letter. Early dot matrix printers had only seven needles and were unable to produce proper lower case descenders. Later models have nine needles and some expensive printers now fill in the letters producing results that are comparable to an ordinary typewriter. The flexibility that comes of being able to change any character by altering the software makes dot matrix printers attractive for scientific work, graphics, and foreign correspondence. Some dot matrix printers cost considerably more than daisy-wheel printers.

Choosing peripherals

Daisy-wheel printers have formed characters which strike a fabric or carbon ribbon to give a clean character impression. As a general rule, these printers are suitable for business correspondence and the prices at the bottom end of this market are becoming competitive with some dot matrix printers. But, what about the speed of the cheap daisy-wheel machine? Is 12 characters per second (cps) acceptable or must you have the 80 cps that you can expect from an Epson MX-80 printer? How well will the printer wear in the conditions of your application? There is a great difference between printing bank statements for 12 hours a day and producing ten single page letters a week with a draft financial statement for the sports club on the side.

After looking at the hardware requirements from as many different angles as you can find, move on to the software. Really the two parts of the analysis co-exist. If the hardware is unsuitable it makes no difference what software is available. If the software won't do the job, the hardware is just an expensive doorstop. Does your friend want to buy the software ready-made or is someone going to write it specially for the application?

Development of the system

Many small machines like the Acorn Atom, Sinclair ZX-81, MZ-80K, Video Genie, and Texas TI-99/4 have some business software available. Other machines are more specialised, I have seen very little non-games software for the Vic-20, and the Nascom family is supposed to be more comfortable in laboratory or industrial applications. Is access to the huge range of software available under CP/M needed?

Choice of a real computer and the best programs depends on the systems analysis that you carry out. One of the most important parts of that analysis will be the future development of the system. Will the number of records that have to be stored increase in number and size or stay about the same? Will other applications be added to the original purpose of the machine and how will the available operating time be allocated?

Systems analysis is just a way of approaching a problem. It is a way of discovering what the limits of the problem are and how a way through can be found. ■

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

ASTEROID SPIN

■ I am 12 years old and use a Model A BBC Micro. I have recently been trying to make a program based on Asteroids. When programming it, however, I faced the problem of rotating the ship. Please tell me how I can do this.

Andrew Charity, Northwich, Cheshire.

AS YOU ARE working on a Model A, memory is at a premium. You do not say which mode you are working in, and this can make a difference. To rotate your ship, you need to define eight different ships, one facing in each direction, and then use a routine within the program to choose the correct ship for the direction you are moving. The alternative to this, and one which may be acceptable if you are short of memory, is to settle for four — rather than eight — directions, and use the A, V and the greater than and less than symbols to represent the ship facing up, down, right and left respectively.

FAMILY TREE

■ As an amateur genealogist, I want to put my records into the more rapid retrieval system of the ZX-81. I have at present 42 different surnames which are connected with my family. Between the 42 families thre are 160 children. The ideal program would be in three distinct parts:

- A list of all the surnames in the directory
- A list of all the people of each surname
- Details of each family

I started working on the program, giving each name a unique code number, derived from the initial letter of the surname followed by a sequential number starting from one. I want to refer to that code number and get a list of all the people with that surname, each with its own unique code number. By referring to that code number, details of that person's family would be displayed. Am I expecting too much from my ZX-81?

Michael Brady, Nottingham.

I SEE NO reason why the Sinclair Vu-File program, or a similar program, should not work perfectly for your needs. In essence you need a simple sort program, which allows elements from other parts of the file to be linked. You need a master array which holds the name and the code number, complete with the "extra information" such as birthplace, marriage, birth and death dates. The code number must be forced to carry more weight. It should hold the following information, to stop it being a deadweight:

- Surname: the first four letters of the surname could be the first four elements of the code
- A number showing whether married or not
- A number showing offspring
- A three-digit number for birth, and one for death — the birth date minus the leading 1, as 861 for 1861, and so on.

This is only a suggestion, as I do not know how you wish to manage the data. Your coding system is the key to the whole program. You should find that you can hold a limited amount of information on 160 people easily within 16K.

SPECTRUM SCROLL

■ I have written a simple 1K ZX-81 Asteroids program which I would like to use on my Spectrum, adding, say, colour to the program, which in its ZX-81 version reads:

```
10 LET D = 0
20 LET B = 15
30 PRINT AT 10,B;
40 IF PEEK (PEEK 16398 + PEEK
   16399*256) = CODE "*" THEN
   GOTO 110
50 PRINT "0"
60 LET D = D + 1000
70 PRINT AT 20,RND*30;"*"
80 SCROLL
90 LET B = B + (INKEY$="0") -
   (INKEY$="1")
100 GOTO 30
110 PRINT "KERBOOM"
120 PRINT "YOU TRAVELLED FOR
   ";D;" LIGHT YEARS"
130 PAUSE 4E4
140 CLS
150 RUN
```

Line 80 is the problem, because there is no Scroll command on the Spectrum. Could you suggest a solution?

David Matthews, Carnforth, Leicestershire.

THERE ARE A few things you can simplify about this program on the Spectrum. Instead of using Scroll, you can use Poke 23692, -1. Change line 130 into Pause 0, and delete 140, as the Spectrum automatically clears the screen when running. Changle line 30 into

```
IF SCREEN$ (10,B) = "*" THEN
GOTO 110
```

and delete line 40. Change line 50 into

```
PRINT AT 10,B;"0"
```

POLICY FILE

■ I have recently bought a 1K ZX-81 to replace my rather untidy filing system. I am an insurance agent, and I keep a record of all my customers in a card file. I would like to use my ZX-81 as a complete, easy-to-alter filing system, holding the customer name, addresses, etc. the policy held, and its maturity date. I need to enter over 500 customer details with space to expand as needed. Is there a program available which would meet my needs?

P Gilbert, Brighton, East Sussex.

YOUR PROGRAM NEEDS are not, in themselves, too complex, but you need to know what you are doing before you begin.

For a start, you could probably not have a file which was infinitely upwardly expandable. You would possibly need to specify at the beginning how many individuals you wanted to set up the file on, so arrays could be created to hold that information. It would not matter if some of the space was kept empty for the time being. This is much simpler than trying to expand a full system later on. I suggest that, in your case, Hilderbay could advise you as to what you would need. And for something as important as your business, I suggest a little extra outlay now could pay dividends. Video Software may also be able to help you.

SCREEN GLITCH

■ I own a ZX-81 and 16K RAM. In May, I sent my computer back because it kept crashing too frequently. Now, almost everytime I switch on with the new ZX-81 I get a white bar about two inches wide. When it reaches the bottom of the screen it seems that the television loses its horizontal hold and moves up, then stops and the white bar starts again. What do you suggest I do?

Matthew Field, Kingston upon Thames, Surrey.

IT SOUNDS to me more like a RAM problem than a ZX-81 problem. I suggest you try out a friend's ZX-81 on your television, and with your RAM pack, and see if the problem occurs. That would isolate it to the RAM pack. Try cleaning the contacts at the back of your ZX-81 with surgical spirit, and then rig up something to ensure that the RAM pack does not wobble when you use it. If you find that these things do not help, I suggest you will have to go without your ZX-81 for a while. Send it back to Sinclair, saying you wrote to me, and that I suggested it could be a problem caused by the combination of the ZX-81 and your particular RAM pack. Send the RAM pack back as well, but make sure you point out in your covering letter that you are enclosing a RAM pack, or they might not send it back to you.

FAST RUNNER

■ In a back issue of *Your Computer* you quoted timings for a simple loop counting from 0 to 1,000, printing out each number during the loop. The timings attained were as follows: Atom — 1 minute 23 seconds; MZ-80K Basic — 50 seconds; MZ-80K Pascal — 22 seconds; BBC Micro — 14 seconds. Spurred on by curiosity, and armed with my trusty stopwatch, I ran the following program:

```
10 FOR P = 0 TO 1000
20 PRINT AT 0,0;P
30 NEXT P
```

These were my results: ZX-81 in Fast mode — 2 minutes 26 seconds; Slow mode — 9 minutes 49 seconds. I am led to ask the following questions:

- **What makes one computer faster than the other?**
- **Is it possible to increase the working speed of the ZX-81?**

J H Weaver, RAF Gutersloh.

A NUMBER OF factors influence the speed of a microcomputer. The computer thinks in binary arithmetic, and must first translate your Basic program into zeros and ones. The efficiency of the process by which a program is changed from a high-level language like Basic to machine code is one factor which affects the speed. The next factor is changing the output back into human-readable information. In the case of the ZX-81, particularly, there is another important factor influencing the change — the way Slow mode works. In Slow mode, the computer spends most of its time keeping the screen picture steady, and only the time *between* refreshes of the picture doing its thinking. That is why Fast is so much faster than Slow. The method of printing on the screen also takes time. The ZX-81 is quite sluggish when printing out numbers on the screen. If you were to delete the middle line of your program you would get some increase in speed, but the only way to increase the speed of the ZX-81 dramatically is to program it in machine code. In fact, when you run tests for speed on various computers, with the test program written in machine code, all you are really testing is which processor the computer is built around, and how well the printing mechanism works.

BASIC NONSENSE

■ We have been trying to type a machine-code loading program for the ZX-81 into a Spectrum. When we run it we get the message "Nonsense in Basic". Can you tell us why?

J Baker, Sowery Bridge, West Yorkshire.

YOU CANNOT run machine-code programs in their ZX-81 form directly on the Spectrum. Your loader depends on the use of information stored in a string, which is accessed and then Poked into position. The character set on the two computers is different, so you would be attempting to load information into the Spectrum which it could only interpret as rubbish. The Spectrum has been designed to make the acceptance of machine code relatively simple, with the use of the Clear to set RAMtop to give you a safe space where you can hold your machine code. ■

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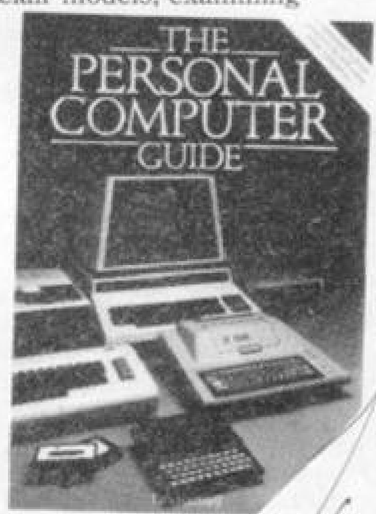
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Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

TEXAS AND SHARP owners have finally come out of their shells in the last couple of weeks and sent in some programs. Maybe they are afraid that their machines are due to be superseded and that this is their last chance.

The first program, by A J Gilbert, is a decimal to base n conversion for the PC-1211.

This program converts a decimal number to an n-base number, where n is any integer from two to 20. The result is accurate to 10 digits of decimal or base, whichever is the lesser.

Unlike other base conversion programs, this one is not truncated at the decimal point, and is very useful for producing hexadecimal or binary values for output to D-A converters.

The same calculation gives budding astronauts a more sophisticated moon-lander game.

This game uses 1,008 bytes of the machine's RAM, which leaves plenty of memory free. When programming the game, do not leave spaces between characters and commands, or you may not be able to complete some lines.

Multifunction lines and low-value line numbers have been used to save memory, for example Goto 170 takes an extra byte compared to Goto 17.

The gravity factor, which lies between three and 12, is a measure of free-fall acceleration. The higher it is, the faster you accelerate. Your height at the start is random between 9,000 and 11,000. Each time your position has changed you are again told your height and speed upwards, amount of fuel and your time.

To go down, burn at 0 — accelerating under gravity; to go upwards, burn at anything above.

The next program is included for its novelty — the only attempt at Golf I have seen on a progr ımmable. It comes, of course, from A Scot.

When run, the calculator will show your hole number followed by the number of strokes taken so far, then the par after the hole you are on, thus: Hole n-n:n. Your number of strokes played so far is then displayed — Strokes = n, then your distance to the hole — Dist, = n.

"Club?" is then displayed. You input the club number you require from 1-8. Your drive distance is then shown: You Hit = n. The game ends after nine holes.

Here is a program by Roy Sirl of Andover which will give successively better approximations of irrational numbers as rationals — that is, fractions. Unfortunately it is not fast — it takes 11 minutes to find the well-known $\frac{355}{133}$ approximation for pi!

The numerator and denominator are stored in memories 5 and 6. The error is stored in memory 7.

Finally, Geoffrey Wood of Horsforth has written a topical program to keep track of petrol costs. This Texas TI-58C program was written originally for use on continental motoring holidays.

When buying petrol — always fill the tank right to the brim, this gives a more accurate figure for the petrol used — prime the program by entering the mileometer reading in Memory 22. You can also note it above the first line of your record card. No need to record the petrol at this stage; the figures from the next time you fill up are used to run the program. All times should be entered in hours and minutes using the 24-hour clock.

To select exchange rate press B. R/S..R/S.. to step through exchange rates. The one in display is the one used in all currency conversions until another is selected.

For a second car's performance press SBR EE to exchange memory banks. Exchange back to the first car is automatic after each run. User-defined keys may be used independently of the main program: A litres → gallons, A[1] gallons → litres, B select, C foreign currency → £, C[1] £ → foreign currency, D foreign currency per litre → pence per gallon.

All you have paid is summed into memory 26 in £s. If you want a running total press RCL 26. All results are displayed rounded to two decimal places. Keep the calculator in Fix 2 mode.

This program will handle both records for two cars independently. Prime memory 21 with the initial mileage of the second car, making sure the tank is full. Next time you fill the second car, press SBR EE to call the subroutine that exchanges the memory banks. This must be done every time you use the program for the second car as the memories for the first car are put back automatically after each run.

Pressing SBR EE also starts the program and causes the mileage at the previous fill-up to be displayed for checking purposes. You do not have to press R/S to start the run as you do for the first car. Otherwise the procedure is identical.

The conversion subroutines can be used independently of the program but since they return to program locations to display you must either switch off or press RST — to return the program pointer to step 0 — before you run the program. Failure to do this will result in the old mileage not being displayed. But you can still press RST and R/S to run the program without doing any damage to the memory contents.

You can put in what exchange rates you like according to the countries you are visiting. If rates alter you can amend the memories without having to edit the program.

Memories 5 to 14 contain exchange rates. You can quickly check through and/or select the memory required by pressing B. The number of each memory is displayed fleetingly followed by a steady display of the contents. R/S repeats this sequence returning to memory 5 after 14. To get out of the loop you must either press RST, switch off or call some other sub-routine. The value in display is also in memory 29 and is recalled for the currency conversion subroutines.

The program is listed with a few explanatory notes.

(continued on next page)

Approximating irrationals as rationals.

Key	Loc	Code
STO 0	00	32 0
1	01	01
STO 7	02	32 7
9	03	09
STO	04	32 1
2nd Lbl 2	05	86 2
1	06	01
SUM 1	07	34 1
RCL 1	08	33 1
÷	09	45
RCL 0	10	33 0
=	11	85
2nd Int	12	49
STO 2	13	32 2
1/x	14	25
×	15	56
RCL 1	16	33 1
+/-	17	84
+	18	75
RCL 0	19	33 0
=	20	85
2nd I×I	21	40
2nd Invx⩾t	22	76
CTO 0	23	51 0
1	24	01
SUM 2	25	34 2
RCL 0	26	33 0
—	27	65
RCL 1	28	33 1
÷	29	45
RCL 2	30	33 2
=	31	85
2nd I×I	32	40
2nd x⩾t	33	76
CTO 2	34	51 2
2nd Lbl 0	35	86 0
STO 7	36	32 7
RCL 1	37	33 1
STO 5	38	32 5
÷	39	45
RCL 2	40	33 2
STO 6	41	32 6
=	42	85
R/S	43	81
GTO 2	44	51 2

Golf program.

```
P0
MAC 9 Min00 LBL9 1 M + 04 AC Min05 RAN                      9
× 400 + 100 = INT Min03 ( MR03 ÷ 70                         25
+ .5 ) = INT M + 01 LBL3 "HOLE AR04-AR02:                   42
AR01" HLT MR05 X = 0 GOTO4 "STROKES = AR05"                 59
HLT LBL4 "Dist. = AR03" HLT MR03 X = 0 GOTO0                74
20 MinF MR03 X = F GOTO1 GOTO2 LBL1 AC                      83
"CLUB?" HLT Min06 X = 0 GOTO1 9 MinF MR06                   97
X = F GOTO1 MR06 × 20 = X ( RAN + .5                        110
) = INT Min07 "YOU HIT = AR07" HLT MR03 -                   128
MR07 = ABS Min03 1 M + 05 GOTO3 LBL2                        136
":G:R:E:E:N:" PAUSE PAUSE MR03 ÷ 8 + 1                      156
= INT Min07 "PUTTS = AR07" PAUSE PAUSE MR07                 171
M + 05 LBL0 MR05 M + 02 "STROKES = AR05" HLT DSZ            188
GOTO9 MR02 - MR01 = X = 0 GOTO6 "# Below Pa                 205
r" GOTO7 LBL6 "# Above Par" LBL7                            222
```

Contents in memories

00 COURSE LOOP	04 HOLE NUMBER
01	05 STROKES
02 TOTAL STROKES	06 CLUB NUMBER
03 DISTANCE	07 DRIVE + PUTT

1. Enter time 1
2. Press E
3. Enter mileage 1
4. Press R/S
5. Switch off Drive on.

1. Enter time 2
2. Press 2nd E[1]
3. Enter mileage 2
4. Press R/S. Read average Kms/hr.

2. Enter time 3
2. Press 2nd B[1]
3. Enter Km to destination

Press R/S

Read time of arrival

1. Enter time 4 (Desired time of arrival).

Press 2nd D[1]. Read average mph required.

Average speed program for petrol costs.

1. Switch on, press R/S.* Read old mileage, enter new mileage.
2. Press R/S, enter fuel, press R/S. If gallons, display reads 0.
2A. If litres;† display reads gallons. Note, press R/S again.
3. Enter money, press R/S. If £; display reads elapsed miles.
3A. If foreign currency;† display reads £. Note, press R/S again.
4. Press R/S. Read mpg.
5. Press R/S. Read pence per mile.
6. Press R/S. Read pence per gallon.
Press RCL 26 to read running total in £§
* For car No. 2 press SBR EE instead of first R/S.
† Conversions are automatic.
§ 0 STO 26 zeroes running total.

Main program for keeping track of petrol costs.

(continued from previous page)

Step	Code	Key	Step	Code	Key
000	43	RCL	120	95	=
001	23	23	121	61	GTO
002	77	GE	122	00	00
003	52	EE	123	13	13
004	43	RCL	124	76	LBL
005	22	22	125	16	A'
006	91	R/S	126	65	×
007	42	STO	127	61	GTO
008	15	15	128	01	01
009	01	1	129	18	18
010	05	5	130	76	LBL
011	32	X:T	131	13	C
012	25	CLR	132	55	÷
013	91	R/S	133	43	RCL
014	77	GE	134	29	29
015	11	A	135	95	=
016	42	STO	136	22	INV
017	16	16	137	86	STF
018	43	RCL	138	01	01
019	29	29	139	61	GTO
020	67	EQ	140	00	00
021	75	-	141	23	23
022	25	CLR	142	76	LBL
023	91	R/S	143	18	C'
024	87	IFF	144	65	×
025	01	01	145	61	GTO
026	13	C	146	01	01
027	44	SUM	147	33	33
028	26	26	148	76	LBL
029	42	STO	149	14	D
030	17	17	150	65	×
031	43	RCL	151	43	RCL
032	19	19	152	28	28
033	49	PRD	153	55	÷
034	17	17	154	43	RCL
035	43	RCL	155	29	29
036	22	22	156	65	×
037	94	+/-	157	43	RCL
038	85	+	158	19	19
039	43	RCL	159	95	=
040	15	15	160	91	R/S
041	95	=	161	81	RST
042	91	R/S	162	76	LBL
043	42	STO	163	75	-
044	18	18	164	22	INV
045	44	SUM	165	86	STF
046	22	22	166	01	01
047	55	÷	167	61	GTO
048	43	RCL	168	00	00
049	16	16	169	22	22
050	95	=	170	76	LBL
051	91	R/S	171	15	E
052	43	RCL	172	88	DMS
053	17	17	173	94	+/-
054	55	÷	174	42	STO
055	43	RCL	175	01	01
056	18	18	176	25	CLR
057	95	=	177	91	R/S
058	91	R/S	178	94	+/-
059	43	RCL	179	42	STO
060	17	17	180	02	02
061	55	÷	181	91	R/S
062	43	RCL	182	76	LBL
063	16	16	183	10	E'
064	95	=	184	88	DMS
065	91	R/S	185	44	SUM
066	81	RST	186	01	01
067	76	LBL	187	25	CLR
068	52	EE	188	91	R/S
069	43	RCL	189	44	SUM
070	22	22	190	02	02
071	48	EXC	191	43	RCL
072	21	21	192	01	01
073	42	STO	193	22	INV
074	22	22	194	49	PRD
075	43	RCL	195	02	02
076	26	26	196	43	RCL
077	48	EXC	197	04	04
078	27	27	198	49	PRD
079	42	STO	199	02	02
080	26	26	200	43	RCL
081	43	RCL	201	02	02
082	23	23	202	91	R/S
083	94	+/-	203	76	LBL
084	42	STO	204	17	B'
085	23	23	205	88	DMS
086	61	GTO	206	42	STO
087	00	00	207	01	01
088	04	04	208	25	CLR
089	76	LBL	209	91	R/S
090	12	B	210	42	STO
091	01	1	211	20	20
092	05	5	212	55	÷
093	32	X:T	213	43	RCL
094	05	5	214	02	02
095	42	STO	215	85	+
096	00	00	216	43	RCL
097	43	RCL	217	01	01
098	00	00	218	95	=
099	77	GE	219	22	INV
100	00	00	220	88	DMS
101	94	94	221	91	R/S
102	66	PAU	222	76	LBL
103	73	RC*	223	19	D'
104	00	00	224	88	DMS
105	42	STO	225	75	-
106	29	29	226	43	RCL
107	91	R/S	227	01	01
108	69	OP	228	95	=
109	20	20	229	35	1/X
110	61	GTO	230	65	×
111	00	00	231	43	RCL
112	97	97	232	20	20
113	76	LBL	233	55	÷
114	11	A	234	43	RCL
115	86	STF	235	04	04
116	01	01	236	95	=
117	55	÷	237	91	R/S
118	43	RCL	238	00	0
119	28	28	239	00	0

Left, the petrol-cost program. Right, the memories section, and far right, the user-defined keys.

Value	Reg	Value	Reg	Value	Reg
5.	00	117.	14	4.544	28
3000.	01	52908.	15	15.	29
113.2732758	02	11.55809859	16		
0.	03	1754.	17		
1.609347088	04	340.	18		
15.	05	100.	19		
80.5	06	164.	20		
4.68	07	52908.	21		
4.27	08	45751.	22		
30.5	09	100.	23		
2320.	10	35.3254485	24		
3.4	11	33.20828258	25		
10.35	12	10.76	26		
93.	13	33.85	27		

Step	Code	Key
068	52	EE
090	12	B
114	11	A
125	16	A'
131	13	C
143	18	C'
149	14	D
163	75	-
171	15	E
183	10	E'
204	17	B'
223	19	D'

Decimal to base n conversion.

```
1:"A"A$(27)="0":A$(28)="1":A$(29)="2":A$(30)="3":A$(43)="G"
2:A$(31)="4":A$(32)="5":A$(33)="6":A$(34)="7":A$(35)="8":A$(36)="9":A$(44)="H"
3:A$(37)="A":A$(38)="B":A$(39)="C":A$(40)="D":A$(45)="I"
4:A$(41)="E":A$(42)="F":A$(12)=".":A$(13)=" ":A$(46)="J"
5:"B"INPUT "BASE=";U:U=INT U
6:IF U<=20THEN 8
7:PAUSE "TOO BIG":GOTO 5
8:IF U>=2THEN 10
9:PAUSE "TOO SMALL":GOTO 5
10:INPUT "DECIMAL=";Z:GOTO 50
11:GOTO 5
50:IF Z<1THEN 95
55:W=Z
60:FOR Y=2TO 11
70:IF W<UTHEN 100
80:W=W/U:NEXT Y
90:PAUSE "TOO BIG":GOTO 10
95:FOR Y=1TO 11:GOTO 150
100:FOR X=1TO Y-1
120:A(X)=INT W+27
130:W=U*(W-INT W)
140:NEXT X
150:A(Y)=12:W=U*(Z-INT Z)
151:IF Y>9THEN 165
152:FOR X=Y+1TO 10
154:A(X)=INT W+27
156:W=U*(W-INT W)
158:IF WTHEN 160
159:FOR V=X+1TO 10:A(V)=13:NEXT V:X=10
160:NEXT X
165:Y=11:NEXT Y
170:PRINT A$(A);A$(B);A$(C);A$(D);A$(E);A$(F);A$(G);A$(H);A$(I);A$(J)
180:GOTO 10
200:"D"AREAD Z:GOTO 50
```

PROGRAM A: INITIALISES POINTERS — NEED ONLY BE DONE ON FIRST RUNNING. CAN ALSO BE ACCESSED BY 'RUN' COMMAND. THEN ENTERS PROGRAM B.

PROGRAM B: SETS BASE 'N' INPUT VALUE IS TRUNCATED, THEN CHECKED FOR BEING BETWEEN 2 AND 20. IF O.K. ENTERS PROGRAM D, OTHERWISE RE-ENTERS PROGRAM B.

PROGRAM D: INPUT DECIMAL VALUE IS CONVERTED TO N BASE AND DISPLAYED AS A 10 DIGIT OR 9 + POINT) FIXED POINT NUMBER WITH LEADING AND TRAILING ZEROS SUPPRESSED ENTERING WITHOUT A VALUE WILL RE-ENTER PROGRAM B.

NOTES: (1) DIGITS 10 THROUGH 19 ARE REPRESENTED BY LETTERS A THROUGH Z
□ = SHIFT ▭ = ENTER
(2) RE-ENTERING B

	Input	Display	Note		Input	Display	Note
1	□ A	BASE =		5	▭	BASE =	2
2	16 ▭	DECIMAL =		6	8 ▭	DECIMAL =	
3	12.5 ▭	C.8	1	7	10.5	12.4	
4	▭	DECIMAL =		8			■

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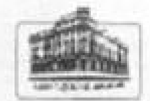
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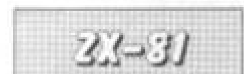
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Small enterprise

Philip Pulsford,
Bristol,
Avon.



I HAVE WRITTEN a mini-version of Star Trek for the ZX-81 which fits in 1K of memory. It has been written using memory-saving techniques.

When the program is run there is a short delay, then the computer shows you which sector you are in and asks for a command.

Command 1 moves you around the galaxy. You will be asked what sector you wish to go to. You can move up, down, right or left.

Command 2 displays a status report from the ship's computer: how much energy you have, how many missiles you have, the number of remaining Klingons and a clue to which sector a particular one is in. For example, Klingons 14:5 means there are 14 Klingons left and one of them is in sector five. Klingons 2:0 means there are two Klingons left but it refuses to tell you where they are. There are three Klingons in the galaxy at one time but the computer will only tell you where one is. When a Klingon is shot another will take its place until all 14 Klingons are dead.

Command 3 fires a torpedo at a Klingon only if it is in the same sector as you, and only if you have some missiles left.

Command 19 will retire you from the game, when no Klingons are left. Your rating will then appear from −7 to +7. You will be automatically retired from the game if a Klingon missile hits you or if you run out of energy.

When you are in the same sector as a Klingon the message "Klingon missile" appears on the screen. The chance of being hit is one in 10.

When you run out of missiles the only way to get some more is to dock with the Starbase by moving into the sector it is in. When this happens the message "Docked" appears. My highest rating is five.

In order to save memory pi was used to great effect. For example:

SGIV = 1, SIN PI = 0

The codes of numbers were also used, for example, Code "■" = 6. The whole list is in Appendix A in the ZX-81 manual. In some cases where the codes of numbers did not exist Val was used, for example:

VAL "4" = 4, VAL "3E3" = 3000

```
   2 LET P=SGN PI
   5 DIM A(CODE "■")
   6 FOR T=P TO SQR EXP PI
  10 LET A(T)=INT (RND*EXP PI)+P
  20 NEXT T
  21 LET E=VAL "3E3"
  22 LET K=CODE ":"
  24 IF E<SGN PI THEN GOTO PEEK
PI
  30 IF P=A(SGN PI) OR P=A(CODE
"■") OR P=A(PI) THEN GOSUB PEEK
SIN PI
  34 IF P=A(CODE "■") THEN GOSUB
 PEEK PEEK PI
  36 PRINT "SECTOR=";P,,"COMMAND
?"
  40 INPUT C
  45 LET E=E-CODE "W"/C
  50 CLS
  60 GOTO C*PI*PI+CODE "W"
  70 PRINT "TO WHERE?"
  71 INPUT M
  72 LET C=ABS (M-P)*(M OR M)
  74 IF C=SGN PI OR C=CODE "■" T
HEN LET P=M
  75 GOTO EXP PI
  80 PRINT "ENERGY=";E,"KLINGONS
=";K;":";A(PI),"MISSILES=";T
  85 GOTO EXP PI
  90 LET A(SGN C+(A(CODE "■")=P)
+(A(C)=P)*CODE "■"-(A(CODE "■")=
A(C)))=INT (RND*EXP PI+SGN C)*(K
>PI OR A(CODE "■")=P)
 100 PRINT "BOOM"
 105 GOTO EXP PI
 155 PRINT "DOCKED"
 160 LET E=E-CODE "PI"
 165 IF T<PI THEN LET T=T+INT PI
 170 RETURN
 220 PRINT "KLINGON MISSILE"
 225 IF K THEN LET K=K-(T>SGN PI
)
 230 LET T=T-(T>SIN PI)
 235 IF RND>VAL ".1" THEN RETURN
 255 PRINT "RATING=";CODE "■"-K
```

Hidden depths

M and S Downes,
Glinton,
Peterborough.



THIS PROGRAM shows an object from any angle, which can then be rotated. In the program a pyramid is used in order to show its use, but any three-dimensional shape can be used. Instructions for this are given in the program. If the shape is plotted near the edge of the screen then the shape may become distorted.

The keys U, D, L, R are used to turn the shape to the required view. These angles are given at the top of the screen and allow standard views to be used. The images may be superimposed and the screen cleared by pressing "c". Line 30 gives red on a yellow background; line 70 gives blue on a white background; lines 120 to 240 contain the input routine for a new shape; lines 320 to 450 work out the screen co-ordinates; lines 560 and 580 contain the X, Y, Z co-ordinates of the pyramid; and line 690 contains the points to which the lines go.

```
>L.>L.
   10 REM 3-D BY M.DOWNES-S.DOWNES
   20  MODE 4
   30  VDU 19,0,3,0,0,0,19,1,1,0,0,0
   40 PRINT''
   50 PRINT "DO YOU WANT INSTRUCTIONS (Y/N)";IN$=GET$;IF IN$="Y" THEN 790 ELSE G
OTO60
   60 CLS
   70   VDU 19,0,7,0,0,0,19,1,4,0,0,0
   80 PRINT''
   90 PRINT"DO YOU WANT AN EXAMPLE OR MAKE YOUR OWN                   (E/O)";IN$=GET$
:IF IN$="E"THEN 560 ELSE GOTO110
  100 GOTO560
  110 CLS
  120  INPUT "NO. OF POINTS",N
  130 INPUT "MAX. NO. OF LINES",M
  140 DIMP(N+1,3+N)
  150  DIM S(N+1,3)
  160 FOR K=1 TO N
  170 PRINT "X";K:INPUT "",P(K,1)
  180 PRINT "Y";K:INPUT"",P(K,2)
  190 PRINT "Z";K:INPUT"",P(K,3)
  200 INPUT "HOW MANY LINES LEAVING THIS POINT",Q
  210 FOR L=1 TO Q
  220 PRINT L;" THIS LINE GOES TO WHICH POINT":INPUT""P(K,3+L)
  230 NEXTL
  240 NEXT K
  250 CLS
  260  INPUT"ANGLE OF VIEW A",A1
  270  INPUT"ANGLE OF VIEW B",B1
  280  PRINT"OBJECT CAN BE MOVED BY USING KEYS:":PRINT' TAB(10)"U-p":PRINTTAB(10
)"D-own":PRINT TAB(10) "L-eft":PRINT TAB(10) "R-ight"''"MOVEMENT SUPERIMPOSED (Y
/N)";SUP$=GET$:IF SUP$="Y" THEN SUP =1 ELSE SUP =0
  290    IF SUP=1 THEN PRINT''PRESS -C- TO CLS DURING PROGRAM"
  300  IF GET$<>""THEN CLS
  310  IF SUP=0 THEN CLS
  320 A=A1*PI/180:B=B1*PI/180
  330 SA=SINA
  340 CA=COS A
  350 CB=COS B
  360 SB=SIN B
  370 FOR K=1 TO N
  380 S(K,2)=(P(K,2)*CA+P(K,1)*SA)*CB+P(K,3)*SB
  390 S(K,1)=P(K,1)*CA-P(K,2)*SA
  400 NEXT K
  410 FOR K=1 TO N
  420  FOR LE=1 TO M
  430 Z=P(K,3+LE)
  440 XO=S(K,1):YO=S(K,2):Y1=S(Z,2)
  450 X1=S(Z,1)
  460  MOVE ABS(XO),ABS(YO):IF X1+Y1<>0 THEN DRAW ABS(X1),ABS(Y1)
  470  IF INKEY$(0)="C" THEN CLS
  480  NEXT LE
  490 NEXT K
  500  PRINT TAB(0,0)A1,B1
  510  A$=GET$:IF A$="L" THEN A1=A1+1
  520  IF A$="R" THEN A1=A1-1
  530   B$=GET$:IF A$="D" THEN B1=B1+1
  540  IF B$="U" THEN B1=B1-1
  550 GOTO310
  560  DATA 500,700,700,500,600
  570  DATA 0,0,200,200,100
  580  DATA 0,0,0,0,200
  590 DIM P(6,5)
  600 FOR A=1 TO 5
  610  READ P(A,1)
  620 NEXTA
  630 FOR A= 1 TO 5
  640  READ P(A,2)
```

(continued on next page)

(continued from previous page)

```
650  NEXT A
660  FOR A=1 TO 5
670  READ P(A,3)
680  NEXTA
690  DATA 2,5,3,5,4,5,1,5,0,0
700  FOR A=1 TO 5
710  FOR B=1 TO 2
720  READ P(A,3+B)
730 NEXTB
740 NEXTA
750  N=5:M=2
760  DIM S(N+1,3)
770 CLS
780 GOTO260
790  CLS :PRINT"FOR AN INPUTED OBJECT COUNT THE NO. OF  VERTICES"'"A SQUARE BA
SED PYRAMID HAS 5 VERTICES"''"TO FORM THE OBJECT, LINES ARE NEEDED.   THE MAX NO
 OF LINES COMING FROM 1 POINT IS COUNTED"'
 800 PRINT"A SQUARE BASED PYRAMID HAS A MAX. NO. OF2(THOUGH 3 LINES COME OUT 1
IS COVERED  BY ANOTHER VERTIX)"
 810 PRINT
 820  PRINT"IF THE OBJECT IS IMAGINED IN A 3-D GRID THEN THE CO-ORDINATES CAN B
E ENTERED    USING X,Y,Z"
 830 PRINT
 840  PRINT"X WORKS BEST BETWEEN 500-700"
 850  PRINT"FOR BASE Y=0"
 860  PRINT"FOR FOREGROUND Z=0"
 870  IF GET$<>"" THEN GOTO60
>VDU3
```

Scroll colour

Bill Longley, Colchester, Essex.

SPECTRUM

MOST ZX-81 USERS will have a selection of machine-code routines for inverting the display and scrolling in different directions. Unhappily for those who upgrade to a Spectrum, these are not compatible with the high-resolution display file. But many of the principles remain the same and here are three typical subroutines for the Spectrum.

The first two are the up-and-down scrolling routines, but here they scroll colour while the text remains still.

The third is an ordinary screen invert routine. It will exchange the ink dots for paper dots, and vice versa. This probably only makes sense to Spectrum users.

Three separate Rems are used to store the routines, so one routine can be used on its own. If you make sure each Rem has 32 characters — remember a colour control code is two — then each routine starts at an address which is 38 greater than the last: so the first starts at 23760, the next at 23798, the third at 23836 and so on.

One last point: it makes good sense to save each routine on tape — with different line numbers — and Merge them into your program as you need them.

```
   1 REM zzzzzzzzzzzzzzzzzzzzzzz
zzzzzzzzz
   2 REM zzzzzzzzzzzzzzzzzzzzzzz
zzzzzzzzz
   3 REM zzzzzzzzzzzzzzzzzzzzzzz
zzzzzzzzz
  10 FOR g=23760 TO 23785: READ
a: POKE g,a: NEXT g
  20 FOR g=23798 TO 23823: READ
a: POKE g,a: NEXT g
  30 FOR g=23836 TO 23855: READ
a: POKE g,a: NEXT g
 497 REM
 498 REM  COLOUR SCROLL UP
 499 REM
 500 DATA 13,17,0,88,33,32,88
 501 DATA 1,160,2,237,176
 502 DATA 1,160,90,58,141,92
 503 DATA 30,32,2,3,29,200,24,25
0
 997 REM
 998 REM  COLOUR SCROLL DOWN
 999 REM
1000 DATA 13,33,223,90,17,255,90
1001 DATA 1,255,2,237,184
1002 DATA 1,0,88,58,141,92,30,32
1003 DATA 2,3,29,200,24,250
1497 REM
1498 REM    INVERTER
1499 REM
1500 DATA 33,0,64,1,0,24,126,47
1501 DATA 119,35,11,62,0,184
1502 DATA 32,246,185,32,243,201
?
USR 23761 CALLS SCROLL COLOUR UP
USR 23799 CALLS SCROLL COLOUR
DOWN.
USR 23836 CALLS THE INVERTING
ROUTINE.
```

Sketchpad

J Laidlaw, Aberdeen.

MZ-80K

SKETCHPAD is a program that writes programs. It enables the user to draw a map, diagram, or picture on the screen using the Set and Reset functions. Sketchpad then writes a very simple program to recreate the drawing, which can then be incorporated into a larger program.

This program was written for a Sharp MZ-80K, but should be easy to convert to the MZ-80A, and other similar micros. SketchPad itself occupies only 1.6K, but requires about 23K of free memory in which to store an array and the new program. Instructions and comments are contained within the program, but here is a list of the more important variables:

I is the increment between line numbers: H is the first line number minus I; J is the number of program lines on the screen; L is the number of groups of data per program line; Q is the total number of data items: X and Y are the co-ordinates of the cursor. The program also contains three Pokes. The first removes the Peek protect, whilst the other two allow a computed Goto statement.

```
 10 REM  *** SKETCH PAD in 1.6K ***
 20 REM Set up array & variables
 30 DIMZ(49,79):H=4990:I=10:L=11:J=0:G=16:X=39:Y=24:F$=","
 40 REM Pokes to remove peek protect & allow computed GOTO
 50 POKE10167,1:POKE7388,140:POKE7389,25
 60 REM Instructions
 70 PRINT"■";TAB(G-2);"SKETCH PAD"
 80 PRINT"■YOUR CONTROLS:-"
 90 PRINTTAB(G);"Q W E":PRINTTAB(G);" \|/ ":PRINTTAB(G);"A-S-D"
 100 PRINTTAB(G);" /|\ ":PRINTTAB(G);"Z X C"
 110 PRINT"■Pressing 'S' will let the moving cursor draw a line."
 120 PRINT"■Pressing 'CR' will let the cursor move  without drawin
g a line."
 130 PRINT"■Press the bottom-right graphic key to   end."
 140 PRINT"          Press CR to continue"
 150 GETA$:IFA$=""GOTO150
 160 PRINT"■":SETX,Y
 170 REM Control the 'cursor'
 180 GETA:K=PEEK(17828)
 190 REM K=the ASCII code of the key currently depressed
 200 IFK=102THENP=2
 210 IFK=83THENP=1
 220 IFP=1THENSETX,Y:Z(Y,X)=1
 230 IFP=2THENRESETX,Y:Z(Y,X)=0
 240 IFK=124GOSUB390
 250 IFK=81THENX=X-1:Y=Y-1
 260 IFK=87THENY=Y-1
```

```
270 IFK=69THENX=X+1:Y=Y-1
280 IFK=65THENX=X-1
290 IFK=68THENX=X+1
300 IFK=90THENX=X-1:Y=Y+1
310 IFK=88THENY=Y+1
320 IFK=67THENX=X+1:Y=Y+1
330 IFX>79THENX=79
340 IFY>49THENY=49
350 IFX<0THENX=0
360 IFY<0THENY=0
370 SETX,Y:Z(Y,X)=1:GOTO180
380 REM Sort out elements of array that are SET (contain 1)
390 PRINT"■■■■":FORA=0TO49:FORB=0TO79
400 IFZ(A,B)=1GOSUB430:Q=Q+1
410 NEXTB,A:PRINT"■  ";:GOSUB520:GOSUB480:GOTOH+1
420 REM     *** Subroutines ***
430 REM Sort array into data lines
440 IFL>10THENL=0:H=H+I:J=J+1:IFJ>7GOSUB480
450 IFL=0THENPRINT"■ ":PRINTH;" DATA ";
460 A$=STR$(A):B$=STR$(B):PRINTB$+F$+A$+F$;:L=L+1:RETURN
470 REM End one page of DATA & resume
480 PRINT"■ ":PRINT"GOTO500":PRINT"Enter the above lines by using
'CR'.■":END
490 REM Restart line for GOTO command
500 PRINT"■■■■":J=1:RETURN
510 REM Print line that READS & SETS the DATA
520 PRINT"■ ":PRINTH+1;" FOR A=1 TO";Q;":READ B,C:SET B,C:NEXT A■
":RETURN
```

Standard deviations

L Cooper,
Bulwell,
Nottingham.

ZX-81

THIS PROGRAM is for normally-distributed samples where X is the size of each category and F(X) is the number of times this value occurs in the sample.

The mean, standard deviation and variance are calculated. These values are of particular use in comparing different samples.

```
STANDARD DEVIATION
  1 REM L COOPER
 10 LET N=0
 11 LET SUM FX=0
 12 LET SUM F=0
 13 LET SUM D2=0
 14 LET D=0
100 PRINT "HOW MANY VALUES OF X
?"
110 INPUT NX
120 DIM X(NX)
130 DIM F(NX)
140 PRINT "FIRST X=?"
150 INPUT FX
160 PRINT "LAST X=?"
170 INPUT LX
180 PRINT "INTERVAL=?"
190 INPUT IN
200 FOR Z=FX TO LX STEP IN
210 PRINT "FOR X=";Z;"   INPUT F
(X)"
215 INPUT F
220 LET X(Z)=Z
230 LET F(Z)=F
240 PRINT "X=";X(Z),"F(X)=";F(Z
);"      CORRECT ?     (Y,N)"
250 INPUT A$
260 IF A$="N" THEN GOTO 210
270 CLS
280 NEXT Z
300 PRINT "ALL VALUES OF X AND
F(X) ENTERED"
400 FOR Z=FX TO LX STEP IN
410 LET N=N+F(Z)
420 LET SUM FX=SUM FX+X(Z)*F(Z)
430 LET SUM F=SUM F+F(Z)
440 NEXT Z
450 PRINT "MEAN OF X=";SUM FX/S
UM F
460 PRINT "SAMPLE SIZE=";NX
470 LET MEAN=SUM FX/SUM F
490 FOR Z=FX TO LX STEP IN
500 LET D=MEAN-X(Z)
505 IF D<0 THEN LET D=0-D
510 LET SUM D2=SUM D2+(D*F(Z))*
*2
520 LET N=N+F(Z)
530 NEXT Z
540 LET SD=SQR (SUM D2/N)
550 PRINT "STANDARD DEVIATION="
SD
560 PRINT "VARIANCE=";SD**2
570 PRINT ,,"ONE STANDARD DEVIA
TION=              ";MEAN-SD;" TO ";
MEAN+SD
580 PRINT ,,"TWO STANDARD DEVIA
TIONS=             ";MEAN-SD*2;" TO
";MEAN+SD*2
590 PRINT ,,"THREE STANDARD DEV
IATIONS            ";MEAN-SD*3;" TO
";MEAN+SD*3
600 PRINT " CONT ?"
610 IF INKEY$="" THEN GOTO 610
615 CLS
620 PRINT "X=","F(X)="
630 FOR Z=FX TO LX STEP IN
640 PRINT X(Z),F(Z)
650 NEXT Z
```

Little black book

P Hintjens,
Edinburgh.

VIC-20

THIS PROGRAM allows you to store names and telephone numbers on a tape file. Entries can be retrieved and amended. Instructions are given in the listing.

```
100 REM "PHONE PAD (C) P.HINTJENS 7/7/82
110 POKE650,255:IFFRE(I)<1000THENMAX=25:GOTO150
120 IFFRE(I)<4100THENMAX=110:GOTO150
130 IFFRE(I)<10000THENMAX=250
140 IFFRE(I)>15000THENMAX=490
150 Y$="■■■■■■■■■■■■■■■■■■■■■■"
160 N$="                      "
170 DIMT$(MAX,2):TN=0
180 GOTO440
190 PRINT"■PAGE "P$
200 PRINTLEFT$(Y$,20)"■────────────────■"
210 PN=0:IFTN=0GOTO260
220 FORI=1TOTN:IFLEFT$(T$(I,1),1)=P$GOTO240
230 NEXT:GOTO260
240 FORJ=ITOTN:IFLEFT$(T$(J,1),1)<>P$THEN260
250 PRINTT$(J,1)TAB(11)T$(J,2):PN=PN+1:NEXT
260 PRINT"■■■■■■■"PN"OF"TN"NAMES":RETURN
270 P=P+1:IFP=27THENP=1
280 P$=CHR$(P+64):GOTO550
290 P=P-1:IFP=0THENP=26
300 P$=CHR$(P+64):GOTO550
310 PRINT"■■"TAB(8)"HELP"
320 PRINT"■■ COMMANDS AVAILABLE IN DISPLAY/EDIT MODE"        "
330 PRINT"■ (FUNCTION KEYS)"
340 PRINT"■ ■+ ■-SEE ■NEXT■ PAGE":PRINT" ■- ■-SEE ■PREVIOUS■ PAGE"
350 PRINT"■ ■F1■-■ADD NEW■ ENTRY":PRINT" ■F3■-■ALTER■ ENTRY":PRINT" ■F5■-■DELETE
■ ENTRY"
360 PRINT" ■F7■-RETURN TO ■MENU■"
370 PRINT"■■■PRESS 'F7' TO CONTINUE■";
380 GETA$:IFA$<>"■"GOTO380
390 RETURN
400 INPUT">NAME";A$:A$=LEFT$(A$,10):P$=LEFT$(A$,1):IFJ=1THENRETURN
410 PRINTLEFT$(Y$,22)N$LEFT$(Y$,21):INPUT">NUMBER";B$:B$=LEFT$(B$,10):RETURN
420 FORI=1TOTN:IFA$=T$(I,1)THENRETURN
430 NEXT:PRINTLEFT$(Y$,22)A$" NOT FOUND";:FORI=1TO2000:NEXT:GOTO550
440 PRINT"■■ ***  PHONE PAD  *** ■";
450 PRINT"■ ■MENU■":PRINT"■ CHOOSE ONE OF:":PRINT"■■ 1-LOAD OLD NAME FILE"
460 PRINT"■ 2-SAVE NEW NAME FILE":PRINT"■ 3-ALTER/DISPLAY FILE"
470 PRINT"■■■■■■■■────────────────"
480 PRINT"■ FOR HELP,TYPE ■H■"
490 POKE198,0:PRINT"■■■■■■■ ■CHOICE■ ? ■■";:WAIT198,1:GETA$:PRINTA$;
500 IFA$="H"THENPRINT"ELP":FORJ=1TO600:NEXT:GOSUB310:GOTO440
510 PRINT:IFA$<"1"ORA$>"3"THENPRINT"■ DON'T BE SILLY!":FORJ=1TO600:NEXT:GOTO440
520 I=VAL(A$):PRINT"■ OKAY":FORJ=1TO600:NEXT
530 ONIGOTO770,880,540
540 P=1:P$="A"
550 GOSUB190:PRINTLEFT$(Y$,21)">■■";
560 GETA$:IFA$=""GOTO560
570 IFA$="+"GOTO270
```

(continued on page 87)

(continued from page 85)

```
580 IFA$="-"GOTO290
590 IFA$="■"GOTO440
600 IFA$="H"THENGOSUB310
610 IFA$="■"THENPRINT"■ALTER NAME■":GOTO720
620 IFA$="■"THENPRINT"■NEW NAME■":GOTO650
630 IFA$="■"THENPRINT"■DELETE NAME■":GOTO750
640 GOTO550
650 IFTN=MAXTHENPRINT"SORRY, LIST IS FULL":FORI=1TO2000:NEXT:GOTO550
660 J=0:GOSUB400
670 FORI=0TOTN:IFT$(I,1)>A$THEN690
680 NEXT
690 TN=TN+1:IFTN=1THEN710
700 FORJ=TNTOI+1STEP-1:T$(J,1)=T$(J-1,1):T$(J,2)=T$(J-1,2):NEXT
710 T$(I,1)=A$:T$(I,2)=B$:GOTO550
720 J=1:GOSUB400
730 GOSUB420:PRINTLEFT$(Y$,21)">NEW NAME AND NUMBER:"
740 J=0:GOSUB400:T$(I,1)=A$:T$(I,2)=B$:GOTO550
750 J=1:GOSUB400
760 GOSUB420:TN=TN-1:FORJ=ITOTN:T$(J,1)=T$(J+1,1):T$(J,2)=T$(J+1,2):NEXT:GOTO550
770 PRINT"J■ ***  PHONE PAD  ***  ■";
780 PRINT"■ PLEASE POSITION THE   TAPE CONTAINING YOUR  OLD NAME LIST."
790 PRINT"■ PRESS 'F7' WHEN YOU   HAVE THE FILE READY."
800 GETA$:IFA$<>"■"GOTO800
810 OPEN1,1,0
820 PRINT"■ OKAY, READING"
830 INPUT#1,TN:PRINT"■"TN"ENTRIES IN FILE"
840 FORI=0TOTN:INPUT#1,A$:INPUT#1,B$
850 IFI<=MAXTHENT$(I,1)=A$:T$(I,2)=B$
860 NEXT:CLOSE1
870 GOTO440
880 PRINT"J■ ***  PHONE PAD  ***  ■";
890 PRINT"■ PLEASE POSITION THE   TAPE FILE FOR YOUR    NEW NAME LIST."
900 PRINT"■ PRESS 'F7' WHEN YOU   HAVE THE FILE READY."
910 GETA$:IFA$<>"■"GOTO910
920 OPEN2,1,1,"PHONE LIST"
930 PRINT"■ OKAY, WRITING"
940 PRINT#2,TN:PRINT"■"TN"ENTRIES IN FILE"
950 FORI=0TOTN:PRINT#2,T$(I,1):PRINT#2,T$(I,2):NEXT
960 CLOSE2
999 GOTO440
```

High-res graph

Julian Stradling,
Portsmouth,
Hampshire.



THIS IS A high-resolution graph-plotter and regressional analysis program for the ZX-81 with the ZX Printer. This program will accept any number of pairs of co-ordinates, plot them on an accurate graph, and plot a best-fit line through them, giving the gradient and the intercepts of that line on both axes.

Listing 1 shows the high-resolution plot routine contained in programs 6 and 7 of the ZX Printer manual, with line 2 reserving the necessary memory, and line 3 switching the computer to fast mode.

Listing 2 first asks for the number of pairs of co-ordinates, which should be numbered 1 to N, and then requests the scale of the graph. For maximum accuracy, the smallest and largest X and Y co-ordinates should be entered. If you want to highlight one particular area of the graph, then it is more accurate to enter the smallest and largest X and Y co-ordinates of the area you wish to display.

Lines 105 to 120 make sure that the axes are included on the graph but, here again, in some cases it would be more accurate to omit these lines, and to include the axes in the display.

Listing 3 asks for each pair of co-ordinates to be entered in turn and line 197 records them on the printer.

Lines 220 and 225 convert them into a number between 0 and 255 to be plotted on the printer. Note that the bottom line of the plot is not printed using the Sinclair high-resolution plot routine, and the Y-co-ordinate scale is adjusted accordingly in line 225.

Lines 230 to 240 record each point as a tiny cross, as a dot is particularly difficult to see.

Listing 4 prints the gradient of the best-fit line, and the intercepts on both axes. The machine will at this point go quiet for three minutes before it starts to plot the graph, and it takes about nine minutes before the graph is finished.

Listing 5 plots the best-fit line. It does this by drawing a straight line between the co-ordinates (U,V) and (W,Z) which are the extremities of the best-fit line on the display used.

Lines 270 to 308 calculate U,V,W and Z, and lines 325 to 365 draw the line.

Listing 6 plots the X- and Y-axes, if they appear on the display. The example I have included is taken from an experiment to measure the speed of sound using a resonance tube. The reciprocal of the frequency of various tuning forks is plotted on the X-axis against the length of tube producing resonance on the Y-axis. The speed of sound is calculated from the gradient of the best-fit line, and the end-correction of the tube is calculated from the intercept on the Y-axis.

Graph 1 shows the plot with both axes. The smallest Y co-ordinate was entered as -2 in order to show the best-fit line cutting the Y-axis.

Graph 2 shows the upper section of the plot in more detail, by deleting lines 105 to 120, and does not display the axes. Note that the numerical values for the gradient and intercepts do not depend on the accuracy of the display.

Each plotted point is given equal weighting when calculating the best-fit line. Hence any obviously wayward point, produced by a hiccup in the results, should not be included when plotting the graph.

LISTING 1

```
   1 REM U■RND.U■RND■" .TAN ..
   2 POKE 16389,124
   3 FAST
   5 FOR I=0 TO 112
   6 POKE 31744+I,PEEK (2161+I)
   7 NEXT I
   8 POKE 31800,63
   9 POKE 31857,201
  10 POKE 16517,95
  11 POKE 16524,79
  12 DIM A$(32,256)
9981 IF X<0 OR X>255 OR Y<0 OR Y
>255 THEN RETURN
9982 LET C=1+INT (X/8)
9983 LET R=256-INT Y
9984 POKE 16526,CODE A$(C,R)
9985 POKE 16527,2**(8*C-INT X-1)
9986 LET A$(C,R)=CHR$ (USR 16514
)
9987 RETURN
9989 FOR I=0 TO 248 STEP 8
9990 FOR J=1 TO 32
9991 FOR K=1 TO 8
9992 POKE 32255+K+8*(J-1),CODE A
$(J,K+I)
9993 NEXT K
9994 NEXT J
9995 FOR H=0 TO 31
9996 POKE 16444+H,H
9997 NEXT H
9998 LET HPRINT=USR 31744
9999 NEXT I
```

LISTING 2

```
  20■PRINT "ENTER NO. OF PTS TO
BE PLOTTED"
  25 INPUT L
  30 PRINT L
  35 PRINT "ENTER LARGEST X-COOR
DINATE"
  40 INPUT BX
  45 PRINT BX
  50 PRINT "ENTER SMALLEST X-COO
RDINATE"
  55 INPUT SX
  60 PRINT SX
  65 PRINT "ENTER LARGEST Y-COOR
DINATE"
  70 INPUT BY
  75 PRINT BY
  80 PRINT "ENTER SMALLEST Y-COO
RDINATE"
  85 INPUT SY
  90 PRINT SY
  95 PRINT "PRESS NEWLINE"
 100 INPUT O$
 105 IF BX<0 THEN LET BX=0
 110 IF SX>0 THEN LET SX=0
 115 IF BY<0 THEN LET BY=0
 120 IF SY>0 THEN LET SY=0
```

LISTING 3

```
 125■LET D=0
 130 LET E=0
 135 LET F=0
 140 LET G=0
 150 FOR J=1 TO L
 155 CLS
 160 PRINT "ENTER X-COORDINATE N
O. ";J
 165 INPUT S
 170 PRINT S
 175 PRINT "ENTER Y-COORDINATE N
O. ";J
 180 INPUT T
 185 PRINT T
 190 PRINT "PRESS NEWLINE"
 195 INPUT O$
 197 LPRINT J;". (";S;",";T;")",
 200 LET D=D+S
 205 LET E=E+T
 210 LET F=F+S*T
 215 LET G=G+S*S
 220 LET X=INT ((S-SX)*249/(BX-S
X)+3)
 225 LET Y=INT ((T-SY)*242/(BY-S
Y)+11)
 230 GOSUB 9980
 232 LET X=X-1
 233 LET Y=Y-1
 234 GOSUB 9980
 235 LET Y=Y+2
 236 GOSUB 9980
 237 LET X=X+2
 238 GOSUB 9980
 239 LET Y=Y-2
 240 GOSUB 9980
 245 NEXT J
 247 LPRINT
 248 LPRINT
```

LISTING 4

```
 250■LET M=(F-D*E/L)/(G-D*D/L)
 255 LET A=(M*D-E)/M/L
 260 LET B=(E-M*D)/L
 261 LPRINT "GRADIENT = ";M
 262 LPRINT "WHEN X=0, Y=";B
 263 LPRINT "WHEN Y=0, X=";A
 264 LPRINT
 265 LPRINT
 266 LPRINT
```

LISTING 5

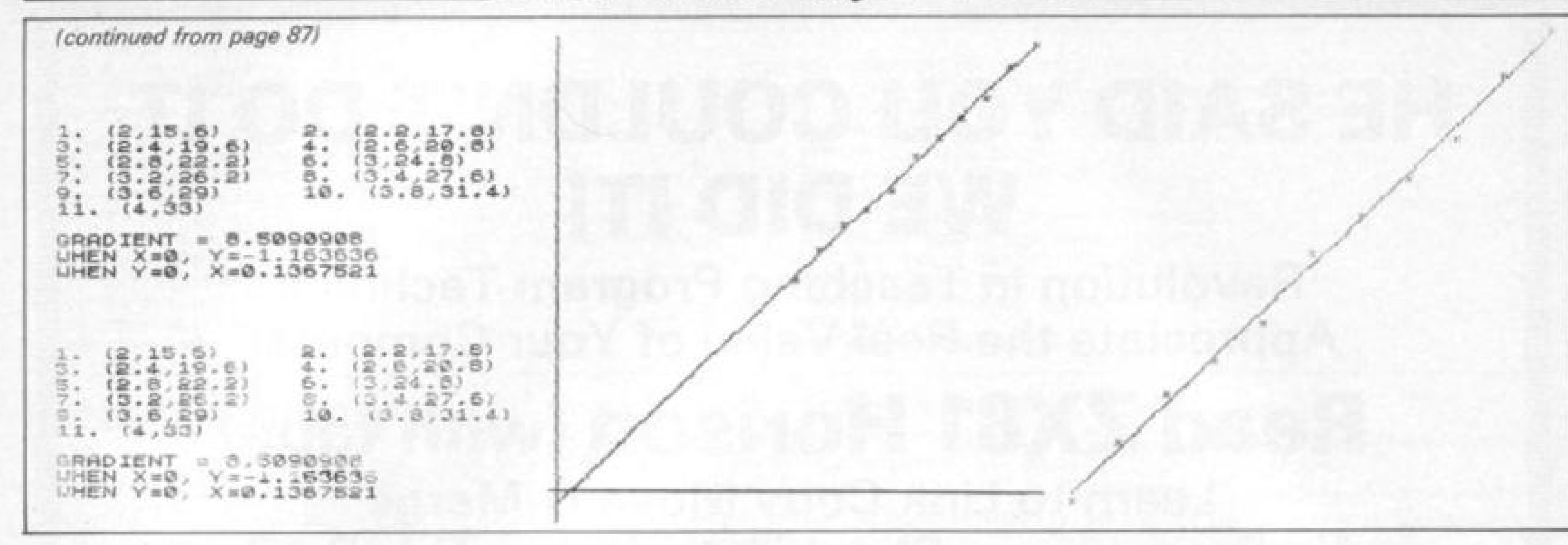
```
 270■IF (BY-B)/M>=SX AND (BY-B)/
M<=BX THEN GOTO 286
 272 IF M>0 THEN GOTO 280
 274 LET U=SX
 276 LET V=M*SX+B
 278 GOTO 290
 280 LET U=BX
 282 LET V=M*BX+B
 284 GOTO 290
 286 LET U=(BY-B)/M
 288 LET V=BY
 290 IF (SY-B)/M>=SX AND (SY-B)/
M<=BX THEN GOTO 306
 292 IF M>0 THEN GOTO 300
 294 LET W=BX
 296 LET Z=M*BX+B
 298 GOTO 310
 300 LET W=SX
 302 LET Z=M*SX+B
 304 GOTO 310
 306 LET W=(SY-B)/M
 308 LET Z=SY
 325 LET D=W-U
 330 LET E=Z-V
 335 LET F=ABS D
 340 IF ABS E>F THEN LET F=ABS E
 345 FOR G=0 TO F STEP (F/256)
 350 LET X=INT ((U+G*D/F-SX)*249
/(BX-SX)+3)
 355 LET Y=INT ((V+G*E/F-SY)*242
/(BY-SY)+11)
 360 GOSUB 9980
 365 NEXT G
```

LISTING 6

```
 450■FOR Y=0 TO 255
 455 LET X=INT (-SX*249/(BX-SX)+
3)
 460 GOSUB 9980
 465 NEXT Y
 470 FOR X=0 TO 255
 475 LET Y=INT (-SY*242/(BY-SY)+
11)
 480 GOSUB 9980
 485 NEXT X
 500 GOTO 9988
```

(continued on page 89)

(continued from page 87)



Label finder

L Kneeling,
South Woodford,
London.

ATOM

YOU ARE NOT supposed to write programs directly on to the screen — you are supposed to do flow diagrams first — but for those who do not know how the program will turn out, here is a facility for the Atom.

This program will print out all those Atom labels with the relevant line number, no matter which text space they are in. All it does is look for the line terminator £0D, and check the memory three bytes ahead, which is where the label should be. It checks that the label and the line number are valid. If they are, then the program prints them out in a table.

The program starts reading memory from £0400, but if you have not expanded your Atom fully, change line 80 to LDA@£29. It finishes at £98 — but if you wish it to stop before it gets to the graphics RAM, then change line 240 to £80.

The two routines in the Atom operating system are C589, which takes a number from £16,£25,£34 and £43, converts it from hex to decimal and prints it in the field width stored in £321. F7FD prints one space.

I am sure that everybody has already found £FFF4 — it is in the manual. If you do not wish to write in the assembly program the hex dump can be entered in with the following routine:

```
10 FOR A=£2890 TO £28EF
20 P.A
30 IN.B
40 ?A=B
50 NEXT
60 END
```

This will put the program into the free space between the FP variables and £2900.

```
10  DIM LL(4)
20  FOR A=1 TO 2;DIM P(-1)
30  P.$21
40
50  :LLO
60  LDA@12
70  JSR£FFF4
80  LDA@£04
90  STA£91
100 LDA@£00
110 STA£90
120 LDY@£00
130 :LL1
140 LDA(£90),Y
150 CMP@£00
160 BEQ LL3
170 :LL4
180 INY
190 CPY@£00
200 BNE LL1
210 :LL2
220 INC£91
230 LDA£91
240 CMP@£98
250 BNE LL1
260 RTS
270 :LL3
280 INY
290 INY
300 INY
310 LDA(£90),Y
320 CMP@96
330 BMI LL1
340 CMP@122
350 BPL LL1
360 DEY
370 DEY
380 LDA(£90),Y
390 CMP@£80
400 BCS LL4
410 STA£25
420 INY
430 LDA(£90),Y
440 STA£16
450 TYA;PHA
460 LDA@£00
470 STA£34
480 STA£43
490 LDA@£05
500 STA£321
510 JSR£C589
520 JSR£F7FD
530 PLA;TAY
540 INY
550 LDA(£90),Y
560 JSR£FFF4
570 JSR£F7FD
580 JMP LL4
590
600 NEXT;P.$6;END
```

HEX DUMP

2890	A9	0C	20	F4	FF	A9	04	85
2898	91	A9	00	85	90	A0	00	B1
28A0	90	C9	0D	F0	0E	C8	C0	00
28A8	D0	F5	E6	91	A5	91	C9	98
28B0	D0	ED	60	C8	C8	C8	B1	90
28B8	C9	60	30	E3	C9	7A	10	DF
28C0	88	88	B1	90	C9	80	10	DD
28C8	85	25	C8	B1	90	85	16	98
28D0	48	A9	00	85	34	85	43	A9
28D8	05	8D	21	03	20	89	C5	20
28E0	FD	F7	68	A8	C8	B1	90	20
28E8	F4	FF	20	FD	F7	4C	A5	28

Sharp breakout

Brian Russell,
Upton St Leonards,
Gloucester.

MZ-80K

HAVING SEEN many games similar to "Breakout" for machines other than the MZ-80K, I decided to write one myself. The program — it is under 2K — will fit any size MZ-80K. The method used to change the ball direction is the same as in the program "Ball Bounced" in the Sharp manual; variables A and B being substituted for S and Z.

The graphics characters in line 40 are a top right-hand graphic, a bottom-right graphic and the rightmost graphic on the second row.

You have six balls. The number of balls left, and also the score, are shown after every ball.

```
10 POKE10167,1
20 SC=0:N=53248+40*(20)+20
30 PRINT"■"
40 FORX=0 TO7:PRINT"▮  ";:FORI=1TO33:PRINT"▀";:NEXTI:PRINT"  ▮":NEXTX
50 FORX=1TO15:PRINT"▮";TAB(38);"▮":NEXT
60 FOR X=1 TO 39:PRINT"■";:NEXT:PRINT"■"
65 STOP
70 FOR X=6 TO 1 STEP -1
80 PRINT"■BALL";X;"   SCORE=";STR$(SC)
90 POKE N+1,0:POKE N,0:POKE N-1,0
100 A=54:C1=39:D=0:E=53248:E1=40:E2=41:E3=39:N=53248+40*(21)+20
110 V=53248+40*(10)+20:V1=71
120 Z=10:S=20:Z1=1:Z2=1:F=220:P=67
130 USR(62)
140 POKE N,A:POKE N+1,A:POKE N-1,A
150 GETA$:A$=CHR$(PEEK(17828))
160 IF A$="▸" THEN N=N-1:POKE N+2,D
170 IF A$="▮" THEN N=N+1:POKE N-2,D
180 USR(71)
190 IF N<54090 THEN N=N+1
200 IF N>54124 THEN N=N-1
```

(continued on page 91)

(continued from page 89)

```
210 G=E+E1*(Z)+S
220 IF Z<1 THEN Z1=-Z1
230 POKE G,V1:FOR I=1TO 10:NEXT I
240 IF PEEK(G-E1)=FTHEN Z1=-Z1:GOTO 350
250 IF PEEK(G-E2)=F THEN 360
260 IF PEEK(G-E3)=F THEN 370
270 IF PEEK(G+40)=P THEN 330
280 IF PEEK(G+E1)=A THEN POKE 4514,20:USR(68):Z1=-Z1
290 IF(S>36)+(S<2)THENPOKE 4514,100:USR(68):Z2=-Z2
300 POKE G,D
310 Z=Z+Z1:S=S+Z2
320 GOTO 140
330 POKE G,D:NEXT X
340 GOTO 380
350 POKE G+E1,0:POKEG,D:SC=SC+1:GOSUB480:GOTO310
360 POKE G+E2,0:POKE G,D:SC=SC+1:Z1=-Z1:GOSUB 480:GOTO 310
370 POKE G+E3,D:POKE G,D:SC=SC+1:Z1=-Z1:GOSUB 480:GOTO 310
380 PRINT"■"
390 PRINT"HIGH SCORE=";
400 IF SC>HS THEN HS=SC
410 PRINTHS
420 PRINT"■■YOUR SCORE=";STR$(SC)
430 PRINT"■■ANOTHER GAME ?(Y/N)"
440 GET R$:IF R$="" THEN 440
450 IF R$="Y" THEN  20
460 IF R$="N" THEN END
470 GOTO 440
480 POKE 4514,1:USR(68):RETURN
```

Pattern memory

John Billingham,
London N21.

BBC

IN THIS PROGRAM, written for the BBC Micro in Mode 5, a series of notes is randomly selected and played. You must try to remember the series, which gradually grows longer, and play it back by using the four cursor keys. Coloured squares also flash on the screen to aid memory. Here are the main variables:

NTE ():	list containing sequence of 30 random numbers
C:	number of notes to be remembered
CC:	note required

These notes should help you understand the program:

10:	dimensions NTE for 30 notes, removes flashing cursor, sets mode, sets character 240 to an inverse space
20:	makes the cursor keys return values
30:	sets colours
40 to 70:	draws blocks of colour and border
80:	randomly selects note sequence
120:	plays note sequence
130:	clears keyboard buffer
140 to 210:	Repeat-Until loop for input of notes
280:	resets cursor keys to editors
290:	resets colours and flashing cursor
300 to 500:	procedures.

```
5     REM Pattern Memory by J.Billingham
10    DIM NTE(30): MODE 5: VDU 23; 8202; 0; 0; 0; 23, 240, 255,
      255, 255, 255, 255, 255, 255, 255
20    *FX 4, 1
30    PROCRESET
40    FOR Y = 0 TO 1: FOR X = 0 TO 1
50    PROCBLOCKS
60    NEXT X: NEXT Y
70    PROCBORDER
80    FOR J = 1 TO 30: NTE(J) = RND(4): NEXT J
90    C = 0
100   C = C + 1
110   CC = 0
120   FOR Q = 1 TO C: PROCFLASH(Q): NEXT Q
130   *FX 15,0
140   REPEAT
150   CC = CC + 1
160   A = GET: IF A > 136 THEN 160
170   IF A = 139 THEN A = 138: GOTO 190
180   IF A = 138 THEN A = 139
190   IF A = NTE(CC) + 135 THEN end = FALSE ELSE end = TRUE
200   IF end = FALSE THEN PROCFLASH(CC) ELSE SOUND 0,-15,1,17:
      SOUND 0,-15,2,7
210   UNTIL end OR CC = C
220   IF end THEN 240
230   FOR Z = 1 TO 2000: NEXT Z: GOTO 100
240   CLS: PRINT ' "YOU MANAGED"; C-1' "ANOTHER GAME?"
250   *FX 15,0
260   IF GET$ = "Y" THEN CLS: GOTO 20
270   IF GET$ <> "N" THEN 250
280   *FX 4,0
290   VDU 23; 29194; 0; 0; 0; 20: END
300   DEF PROCBLOCKS
310   COLOUR (X + 2*Y)
320   FOR X1 = X*9 + 1 TO X*9 + 9: FOR Y1 = Y*15 + 1 TO Y*15 +15
330   PRINTTAB(X1,Y1); CHR$(240);
340   NEXT Y1: NEXT X1
350   ENDPROC
360   DEF PROCBORDER
370   FOR J = 0 TO 30: PRINTTAB(0,J); "S"; TAB(19,J); "S";:
      NEXT J
380   FOR J = 0 TO 18: PRINTTAB(J,0); "S"; TAB(J,31); "S";: NEXT J
390   ENDPROC
400   DEF PROCFLASH(S)
410   SOUND 2,-15,100 + 20*NTE(S),5
420   VDU 19, NTE(S) - 1, NTE(S) + 4,0,0,0
430   FOR JJ = 1 TO 200: NEXT JJ
440   PROCRESET
450   IF CC = 0 THEN F = 500 ELSE F = 1
460   FOR JJ = 1 TO F: NEXT JJ
470   ENDPROC
480   DEF PROCRESET
490   VDU 19,0,7,0,0,0,19,1,1,0,0,0,19,2,2,0,0,0,19,3,3,0,0,0
500   ENDPROC
```

Code storage

D L Clay,
Binley Woods,
Coventry.

ZX-81

THERE ARE three ways of storing machine code: in a Rem statement in line 1, in a variable, and above RAMtop.

An alternative method is necessary because if one wants to load a machine-code program for renumbering, and then load in a Basic program to be renumbered, all these methods are useless.

The first two methods lose the machine code on loading the Basic program, and with the third method machine code cannot be loaded.

This difficulty can be overcome by the following method. The code is stored in the spare memory. Here it is not affected by Run or Clear, or by loading a Basic program unless overrun by the program.

This program will give a display showing the various addresses affecting the spare memory. Tests show that the address of the E-Line, for example, may vary by 200 bytes during running, and one may not catch it at its highest. Also, the program, being in Basic, will only test itself.

The Save facility is not required, except during the actual process of Saving. During Save and Load the Run and Clear keys will not be pressed, since no keys are pressed during these periods.

Hence all requirements will be met by using a safe mode normally and switching, when required, to a mode which will save. It is the E-Line which controls the upper limit of saving. So if the E-Line address is moved up by, say, 1K bytes just before saving, then any code in that 1K will be saved. It is necessary to move the E-Line back afterwards for normal use. Also, since in the saved program the E-Line is in the upper position, the E-Line must be moved back after Loading.

All this can be done automatically by three lines added to the end of a Basic program, as shown in figure 1. The lines are saved with the program.

16405 is the address where the upper byte of the E-Line address is stored. The +4 increases the address by four blocks of 256 bytes. The four can, of course, be set as required.

The whole of the spare memory could be saved, but at about 25 seconds per 1K bytes this would take rather a long time on a 16K machine. To start the Save, key Goto 9992 or Run 9992 to save or clear the Basic variables as required. This makes no difference to the machine code.

If the Basic program is not terminated with Stop, or the equivalent, then 9990 Stop should be added. If it is required that the program should run automatically after Saving and Loading then add 9998 Goto N. To understand fully the action one needs to know exactly what Save does when in a program. Save means: Gosub, Save the program from start to finish regardless of where Save occurs in the program. Return to the line following Save and start executing.

When you type Load "PGM", you are telling the micro to Gosub, Load the program, Return to the line after Save, and start executing. Thus the E-Line is automatically moved up before Saving and then back again. After Loading, the E-Line is moved back so that in both cases the program in the computer is ready for normal use.

The only need for care is if, after starting a Save, the Break key is pressed. One should then key Goto 9996 to return the E-Line to normal. Figure 2 shows a simple program which may be used to test the method. Key in the program and then key in as figure 3a.

A(100) is a dimensioned variable and the two numbers Poked in simulate a machine-code program. Now key Goto 10 and one should see the first result shown in figure 3b.

Save everything by keying Goto 9992. Key New, Newline, or switch off and on, and then Load. Goto 10 will give the data as before,

(continued on page 93)



ZX 81 Spectrum

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(continued from page 91)

showing that the variable and code have been Saved and Loaded. Run 10 will show that the variable has gone but the machine code remains. The E-Line address has been reduced by 506 bytes, but if the Save and Load procedure is repeated it will be found that the code remains within the 1K band.

Although the words machine code have been used throughout, data could be saved, and possibly Basic programs parked, ready, after Loading for instant recall.

```
9992 POKE 16405,PEEK 16405+4
9994 SAVE "PGM"
9996 POKE 16405,PEEK 16405-4
9998 GOTO 10
```

FIG.1

```
  10 REM "PGM"
  20 PRINT PEEK 16404+256*PEEK 1
6405
  30 PRINT PEEK 18100;",";PEEK 1
8200
  40 PRINT A(50);",";A(100)
  50 STOP
9992 POKE 16405,PEEK 16405+4
9994 SAVE "PGM"
9996 POKE 16405,PEEK 16405-4
9998 GOTO 10
```

FIG.2

```
DIM A(100)
LET A(50)=50
LET A(100)=100
POKE 18100,10
POKE 18200,20
```

FIG.3A

```
18037
10,20
50,100

17531
10,20
```

FIG.3B

Poly-pen music

Richard Barton, Dagenham, Essex.

VIC-20

THIS PROGRAM will turn your Vic-20, together with a light-pen, into a kind of Stylophone. Simply point the light-pen at the appropriate position on the screen, and touch the pen sensors to start the tone. Chords can be built up as you go.

To stop the tones, just point the pen at the column furthest to the left, touch the sensors and hit any key. All the tones will stop together — tones cannot be stopped selectively. This program uses the Stack light-pen, but others can be substituted with appropriate adjustment of values.

```
1 REM POLYPHONIC PEN.
2 REM FOR UNEXPANDED           VIC.
3 REM USING STACK LIGHT          PEN.
4 REM BY R.BARTON.
10 DEFFNX(X)=INT((PEEK(36870)-49)/4):DEFFNY(Y)=INT((PEEK(36871)-32)/4)
20 PRINT"J"
30 S1=36874:S2=36875:S3=36876:S4=36877:V=36878
50 PRINT"■■■■■■■■■■PITCHES"
60 PRINT"■■■|||||||||||||||||||"
62 PRINT"■■VOICES.
63 PRINT"■■■■■-S1------------------"
64 PRINT"■■■■■-S2------------------"
65 PRINT"■■■■■-S3------------------"
66 PRINT"■■■■■-S4------------------"
67 PRINT"■■■VVVVVVVVVVVVVVVVVVVVVV"
68 PRINT"■■■KILL TONE WITH PEN   AND A KEY IN THIS TAB"
70 POKEV,4
75 WAIT37137,16
76 IFFNY(Y)=10THENP=S1
77 IFFNY(Y)=13THENP=S2
.78 IFFNY(Y)=16THENP=S3
79 IFFNY(Y)=19THENP=S4
81 IFFNX(X)=3THENPOKEP,135
82 IFFNX(X)=4THENPOKEP,147
84 IFFNX(X)=5THENPOKEP,159
86 IFFNX(X)=6THENPOKEP,163
88 IFFNX(X)=7THENPOKEP,175
90 IFFNX(X)=8THENPOKES1,183
92 IFFNX(X)=9THENPOKEP,191
94 IFFNX(X)=10THENPOKEP,195
96 IFFNX(X)=11THENPOKEP,201
98 IFFNX(X)=12THENPOKEP,207
100 IFFNX(X)=13THENPOKEP,209
102 IFFNX(X)=14THENPOKEP,215
104 IFFNX(X)=15THENPOKEP,219
106 IFFNX(X)=16THENPOKEP,223
108 IFFNX(X)=17THENPOKEP,225
110 IFFNX(X)=18THENPOKEP,228
112 IFFNX(X)=19THENPOKEP,231
200 GETS$:IFS$=""THEN75
220 POKES1,0:POKES2,0:POKES3,
    0:POKES4,0:GOTO75
```

Graphic recall

Tony Gillett, Southampton, Hampshire.

ATARI

I HAVE MADE a discovery which should be of interest to Atari users. First, type in this program:

```
10 GRAPHICS 8:COLOR 1
20 PLOT 20,20:DRAWTO 200,20:PLOT 20,150:
   DRAWTO 200,150
```

Now Run it. You should have a rectangle. Now press the System Reset key. Watch what happens when you type:

```
GRAPHICS 1000
```

The rectangle should have reappeared. This will work for any picture or graph that was drawn in graphics mode 8.

Also, this program simulates the Get command in Vic Basic.

```
10 COM A$(1):OPEN# 1,4,0,"K:":GET # 1,A:
   CLOSE# 1:
   A$=CHR$(A)
```

A$ will be what was pressed on the keyboard.

Column Scroll

John Hirst, Chaddesden, Derby.

ZX-81

THIS MACHINE-CODE program fulfils the need of those people requiring to scroll only a limited number of columns, for example, only one half of the screen. With this program it is possible to scroll from one to 32 columns. It is only possible to use this on a ZX-81 with at least 4K of memory, as it requires the display file to be fully expanded.

The following program can be used to enter the machine-code decimal values in figure 1 one number at a time. Line 1 has 40 Xs.

```
1 REM XXXXXXXXXXXXXXXXXXXXXXXXX
  XXXXXXXXXXXXXXX
10 FOR N=16514 TO 16552
20 SCROLL
30 INPUT I
40 POKE N,I
50 PRINT "ADDRESS ";N;"=";I
60 NEXT N
```

After entering the values in figure 1, list the program. At the end of the Rem statement there should be a single X left; if not then you have made a mistake somewhere. Start again.

If all is correct then delete lines 10 to 60 — not line 1, as this holds the machine code. Input as a direct command:

```
RAND USR 16514
```

Now 0/0 should be returned to the bottom left corner of the screen. Now Save the program, and try the following, added to line 1:

```
10 FOR N=0 TO 21
20 FOR I=0 TO 31
30 PRINT AT N,I;CHR$ (N-38)
40 NEXT I
50 NEXT N
60 LET Z-USR 16514
70 PRINT AT 21,16+INT (RND*16); "*"
80 GOTO 60
```

Notice that the machine-code program has been set to scroll the right-hand side of the screen. The scrolled columns are controlled by three locations in the machine code. The first,

(continued on next page)

(continued from previous page)
16518, is the number of the left-most scroll column — this must be in the range 0 to 32. The second, 16532, is the number of columns to be scrolled — this must be in the range 1 to 32. The values of these two locations, when added, must not be greater than 32. The third location, 16542, is used by the program as a control — this must be in the range 33 to 1. The values in 16532 and 16542 when added together must always equal 33.

To alter these values either Poke new values in directly, or from within a program. Here are some examples:

To scroll columns 16 to 31 as in the listing.
POKE 16518,16
POKE 16532,16
POKE 16542,17
To scroll columns 0 to 15 — left-hand side.
POKE 16518,0
POKE 16532,16
POKE 16542,17
To scroll columns 6 to 15, 10 columns.
POKE 16518,6
POKE 16532,10
POKE 16542,23

The scroll can be called in your programs by
LET Z = USR 16514
but do not use Z as a variable in your program as this will change its value.

Figure 1.

Decimal	Z-80 Assembler
42	ld HL, (NN)
12	
64	
1	ld BC, NN
16	
0	
3	inc BC
9	add HL, BC
229	push HL
235	ex HL, DE
225	pop HL
1	ld BC, NN
33	
0	
9	add HL, BC
62	ld A, N
0	
1	ld BC, NN
16	
0	
237	
176	ld ir
60	inc A
254	op N
22	
40	jr z dis
11	
1	ld BC, NN
17	
0	
229	push HL
235	ex HL, DE
9	add HL, BC
235	ex HL, DE
225	pop HL
9	add HL, BC
24	jr dis
235	
201	ret

More character

Colin Ridley,
Bentley,
Walsall.

SPECTRUM

THE ZX SPECTRUM can redefine character codes 144 to 164, but to do this one must enter eight binary digits for each new character. The following program will make this easier and enable Saving and Loading of the whole character set to tape.

Firstly, it prints an eight-by-eight grid with a flashing cursor which can be moved about using 5, left; 6, down; 7, up; and 8, right; to draw the character the same keys are used with the Caps Shift key also depressed.

When the new character is fully drawn, it can be fixed in memory by Caps Shift F. At all times the whole 21 user-definable characters are displayed at the bottom of the screen and the current character is displayed below the grid.

By pressing various keys, the following functions can be obtained:

CAPS SHIFT C Allows you to decide which of the 21 characters you wish to alter.
CAPS SHIFT D Delete current character from memory: becomes a space.
CAPS SHIFT V Prints the current character on to the eight-by-eight grid ready for modification.
CAPS SHIFT S Save character set to tape.
CAPS SHIFT L Load character set from tape.

Once you have saved your required character set it is only necessary to add the line Load "File name" Code into your program to load the graphics.

```
5 REM *** CHARACTER GENERATOR --- BY COLIN RIDLEY *** 27.6.1982
10 LET C=145
20 FOR N=0 TO 6: POKE USR "A"+N,128: NEXT N: POKE USR "A"+7,255
30 PAPER 5: INK 0
40 CLS
50 PRINT AT 1,12;PAPER 7;"Character Generator"
60 PRINT AT 2,12;"Options": PRINT AT 4,12;"F - FIX CHARACTER": PRINT AT 5,12;"C -
CHANGE CHARACTER"
70 PRINT AT 6,12;"D - DELETE CHARACTER": PRINT AT 7,12;"V - VIEW CHARACTER": PRINT
 AT 8,12;"S - SAVE CHARACTERS": PRINT AT 9,12;"L - LOAD CHARACTERS"
80 PLOT 0,168: DRAW 64,0: DRAW 0,-64: DRAW -64,0: DRAW 0,64
90 FOR X=16 TO 64 STEP 8: PLOT X,168: DRAW 0,-64: NEXT X
100 FOR Y=160 TO 112 STEP -8: PLOT 0,Y: DRAW 64,0: NEXT Y
110 LET D$="": FOR D=145 TO 164: LET D$=D$+CHR$ D+" ": NEXT D: PRINT AT 19,1;PAPER
 7;D$
120 LET X=1: LET Y=1
130 PRINT AT X,Y;PAPER 0;FLASH 1;CHR$ 144
140 PRINT AT 10,1;"CHAR ";CHR$ C: PRINT AT 11,1;"CODE ";C
150 PRINT AT 13,1;"Definable Characters"
160 LET C$=CHR$ C
200 PAUSE 0: LET D$=INKEY$: LET D=CODE D$
210 IF D=67 THEN GOTO 400
220 IF D=70 THEN GOTO 500
230 IF D=68 THEN GOTO 600
240 IF D=86 THEN GOTO 700
250 IF D=83 THEN GOTO 800
260 IF D=76 THEN GOTO 900
270 IF [illegible] THEN PRINT AT X,Y;CHR$ 144: LET X=X-1
280 IF [illegible] THEN PRINT AT X,Y;CHR$ 144: LET Y=Y+1
290 IF [illegible] THEN PRINT AT X,Y;CHR$ 144: LET Y=Y-1
300 IF [illegible] THEN PRINT AT X,Y;CHR$ 144: LET X=X+1
310 IF D=11 AND [illegible] THEN PRINT AT X,Y;PAPER 0;" ": LET X=X-1
320 IF D=10 AND [illegible] THEN PRINT AT X,Y;PAPER 0;" ": LET X=X+1
330 IF D=9 AND [illegible] THEN PRINT AT X,Y;PAPER 0;" ": LET Y=Y+1
[illegible] IF D=8 AND Y>1 THEN PRINT AT X,Y;PAPER 0;" ": LET Y=Y-1
350 GOTO 130
400 INPUT "Enter Character # (145-164)";C: IF C<145 OR C>164 THEN GOTO 400
410 GOTO 30
500 PRINT AT X,Y;PAPER 0;" ": LET S=0
510 FOR X=1 TO 8: LET Z=256
520 FOR Y=1 TO 8: LET Z=Z/2: IF SCREEN$ (X,Y)=" " THEN LET S=S+Z
530 NEXT Y: POKE USR C$+(X-1),S: LET S=0: NEXT X
540 IF C>144 AND C<164 THEN LET C=C+1
550 GOTO 30
600 FOR X=1 TO 8: POKE USR C$ + (X-1),0: NEXT X
610 GOTO 30
700 FOR X=1 TO 8: LET Z=128: LET S=PEEK (USR C$ + (X-1))
710 FOR Y=1 TO 8
720 IF S>=Z THEN PRINT AT X,Y;PAPER 0;" ": LET S=S-Z
730 LET Z=Z/2: NEXT Y: NEXT X
740 GOTO 120
800 INPUT "Enter File Name ";N$
810 SAVE N$ CODE USR "A",160
820 GOTO 130
900 INPUT "Enter file Name ";N$
910 INPUT "Start Cassette and hit "ENTER"";A$
920 LOAD N$ CODE
930 GOTO 130
```

Word puzzles

Chris Callender,
Helensburgh,
Strathclyde.

ZX-81

YOU MUST at some time have seen puzzles where you have to find hidden words on a grid. In this program the 16K ZX-81 makes up a puzzle for you, on a 16 by 16 grid with the option of a solution.

When the program is Run the computer will ask for the title of the puzzle. Then it will ask the number of words you want in the puzzle and then what each word is. If you want a difficult puzzle have a friend input the words.

```
 10 REM WORDPUZZLE BY CHRIS
        CALLENDER.
 20 SCROLL
 30 PRINT "WHAT IS THE TITLE?"
 40 INPUT T$
 50 SCROLL
 60 PRINT "HOW MANY WORDS?";
 70 INPUT U
 80 PRINT U
 90 DIM U$(U,16)
100 DIM M$(256)
110 FOR A=1 TO U
120 SCROLL
130 PRINT "WORD ";A;"?"
140 INPUT U$(A)
150 SCROLL
160 PRINT U$(A)
170 NEXT A
180 FOR A=1 TO U
190 LET L=INT (RND*8)+1
200 IF L=1 THEN LET S=1
210 IF L=2 THEN LET S=-1
220 IF L=3 THEN LET S=16
230 IF L=4 THEN LET S=-16
240 IF L=5 THEN LET S=15
250 IF L=6 THEN LET S=-15
260 IF L=7 THEN LET S=17
270 IF L=8 THEN LET S=-17
280 LET Z$=""
290 FOR B=16 TO 1 STEP -1
300 LET Z$=U$(A)( TO B)
310 IF U$(A,B)=" " THEN NEXT B
320 LET P=INT (RND*256)+1
330 LET N=LEN Z$*S
340 IF N+P>256 OR N+P<=0 THEN G
OTO 320
350 FOR B=P TO P+N STEP S
355 IF B/16=INT (B/16) THEN GOT
O 190
360 IF M$(B)<>" " THEN GOTO 190
370 NEXT B
380 LET Z=1
390 FOR B=P TO P+N STEP S
400 IF Z>LEN Z$ THEN GOTO 440
410 LET M$(B)=Z$(Z)
420 LET Z=Z+1
430 NEXT B
440 NEXT A
450 LET S$=M$
460 CLS
470 FOR A=1 TO 256
480 IF M$(A)=" " THEN LET M$(A)
=CHR$ (38+INT (RND*26))
490 NEXT A
500 FOR A=1 TO 256 STEP 16
510 PRINT M$(A TO A+15)
520 NEXT A
530 PRINT ,,"FIND THE FOLLOWING
HIDDEN WORDS"
540 POKE 16418,0
550 FOR A=1 TO U
560 PRINT U$(A);
570 NEXT A
580 PRINT AT 23,0;"SOLUTION?"
590 PAUSE 4E4
600 IF INKEY$<>"Y" THEN GOTO 64
0
610 FOR A=1 TO 256
620 IF S$(A)<>" " THEN PRINT AT
INT (A/16),A-16*INT (A/16);CHR$
(CODE S$(A)+128)
630 NEXT A
640 PRINT AT 23,0;"PRINTER COPY
?"
650 PAUSE 4E4
660 IF INKEY$<>"Y" THEN STOP
670 LPRINT TAB ((32-LEN T$)/2);
T$
680 COPY
```

Undercut

*R Vanhove,
Merelbeke,
Belgium.*

ZX-81

THE IDEA of this game is as follows: both opponents have to choose numbers. The one marked with an asterisk chooses numbers in the range 2 to 6. The other one chooses integers within the range 1 to 5. If the difference between the two numbers given does not equal 1, for example, 3 and 6, 5 and 1, or 4 and 4, both opponents may add that number to their score.

If the difference is 1, however, the player with the lower number must add both to his score, whereas the player with the higher score gets nothing at all. Thus, if A says 3 and B says 2, A gains five points and B nothing. An added frustration which was not in the original game: to win, or draw if your opponent has 100 too, you need 100 exactly — all surplus points are subtracted from 100. The game is for a 1K ZX-81. If you have more memory, you may either improve the computer's end-game or have the computer look for patterns in the human choice — so as to "undercut" him at a hurtful moment — when he plays that six again.

```
1   LET S = PI - PI
2   LET T = S
3   LET V = S
4   CLS
5   PRINT "YOUR TOTAL =";S;"ZX81 TOTAL = ";T; AT 2,16*(NOT V);"*"
6   PRINT,," YOU CHOOSE  ";
7   IF INKEY$ = "" THEN GOTO VAL"7"
8   LET A = VAL INKEY$
9   IF A > VAL "5" + V OR A < PI/PI + V THEN GOTO VAL"7"
10  LET C = RND*CODE "PI"
11  LET B = PI/PI + V*((C > 10) + (C > 36) + ( C > 49)
    + (C > 62.8)) + (NOT V)*(PI/PI + (C > 32) + ( C > 44)
    + (C > 63) + (C > 65))
12  PRINT A,"ZX81 CHOSE  ";B
13  LET C = A*(A - B <> PI/PI) + B*(B - A = PI/PI)
14  LET D = A*(A - B = PI/PI) + B*(B - A <> PI/PI)
15  LET T = T + D
16  LET S = S + C
17  LET U = VAL"100"
18  IF S = U OR T >= U THEN GOTO CODE "2"
19  IF S > U THEN LET S = U +U - S
20  LET V = (NOT V)
21  GOTO VAL"4"
30  PRINT,,,,S;"-";T;" YOU WIN" AND S > T;"ZX81 RULES" AND T > S;
    "THAT WAS CLOSE" AND S = T;W
```

Screen flash

*R M Taylor,
Spalding,
Lincolnshire.*

ZX-81

THIS MACHINE-CODE routine will work on any ZX-81 with 4K or greater memory. Enter a line 1 Rem followed by at least 43 spaces. When you have completed this you must enter the code from address 16514 onwards.

You have no doubt seen many hexadecimal and decimal loader programs for entering machine code so I have not repeated one here. After the code is entered enter, as a direct command,

POKE 16514,1

and run the routine by using

RAND USR 16516

The program should go through the ZX-81's entire character set, ordinary and inverse. The speed at which this happens produces a stunning effect.

The speed can be altered by the value in 16514-16515. It should be noted that a zero in both 16514 and 16515 produces the longest delay. If the screen is filled with different characters before the routine is called, using

RAND USR 16516

as a program line to avoid the screen being cleared, then each character is treated individually which produces an even better effect. It may also be noticed that the screen is always set to its original contents when the routine returns to Basic. This program is useful for producing effects at the end of games.

ADDRESS	DECIMAL	HEX	MNEMONICS
16514	0	00	NOP
16515	0	00	NOP
16516	6,128	06 80	LD B,128
16518	42,12,64	2A 0C 40	LD HL,(16396)
16521	35	23	INC HL
16522	197	C5	PUSH BC
16523	14,24	0E 18	LD C,24
16525	6,32	06 20	LD B,32
16527	126	7E	LD A,(HL)
16528	60	3C	INC A
16529	203,119	CB 77	BIT 6,A
16531	40,4	28 04	JR Z (TO 16537)
16533	203,183	CB,B7	RES 6A
16535	238,128	EE 80	XOR 128
16537	119	77	LD (HL),A
16538	35	23	INC HL
16539	16,242	10 F2	DJNZ (TO 16527)
16541	35	23	INC HL
16542	13	0D	DEC C
16543	32,236	20 EC	JR NZ (TO 16525)
16545	193	C1	POP BC
16546	42,130,64	2A 82 40	LD HL,(16514)
16549	43	2B	DEC HL
16550	124	7C	LD A,H
16551	181	B5	OR L
16552	32,250	20 FA	JR NZ (TO 16549)
16554	16,218	10 DA	DJNZ (TO 16518)
16556	201	C9	RET



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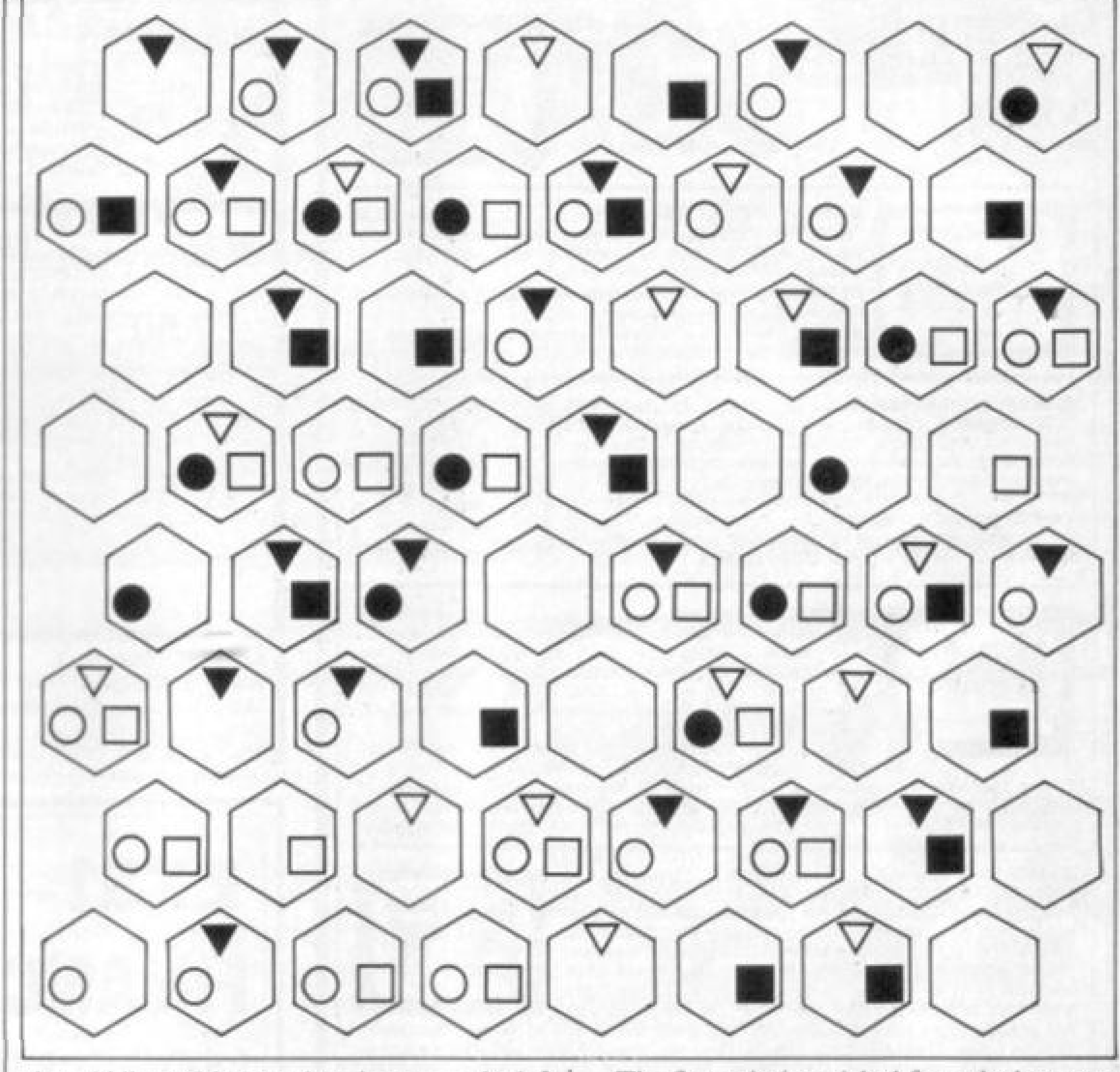
A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in October. The name of the winner, the solution, and a competition report will be published in the December issue of *Your Computer*.

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

ENIGMA CODE

BY ANTHONY ROBERTS

THIS CODED note was passed to you by a strangely-dressed man at a time-traveller's convention: He had the month right, but not the year. It is a simple substitution code: each letter of the original message, in sequence, has been substituted by the code corresponding, in sequence, with that letter of the alphabet: what is the message?



Competition results

DESPITE A LARGE number of entries, the August competition for a Dragon 32 did not inspire such flights of imagination as we have witnessed in previous months. After much pondering we made the winner S J Dawes of Lilac Cottage, Viking Hall, Ripple, Tewksbury, Gloucestershire. He completed the sentence "If I found a Dragon 32 in an Adventure game, I would . . ." with "keep it on a good Basic diet with lots of raw data".

Punsters — as incorrigible as ever — were in good form; as in D Clarke's "try Tolkien to him — then hob it" and D Slinn's "ROMp home singing fangs for the memory".

While a dragon suggested St George and a distressed damsel to many people, R Patterson planned to "make it a Pet by feeding it on Acorns and Apples". Similarly D Blakemore intended to "befriend him by feeding him on nutty slack and fire-lighters".

P Abraham struck a familiar note with "tickle his keys, Peek at his bytes and Poke him to bits"; rather different was J Pittam's nicely irrelevant "turn left at Swansea and take the M4 home".

All the entries for the Power Cube problem gave the correct answer — the black square. Most of them found the problem quite easy to solve without a program. As A While put it "there is really no reason to awaken my BBC model A".

A simple solution can be arrived at if you pair up the symbols on a face. The symbols in the middle positions at the edge cannot be left unpaired. The black square is the only symbol which does not occupy a middle position on any of the faces.

The first solution picked from the bag came from A Smith, "Cwa Ben", Sachelcourt Avenue, Bishopton, Renfrewshire, Scotland, who receives the £15 book token. ■

```
10 REM POWER CUBE SOLUTION BY A.B.SMITH
20 DIMA%(9),A$(9),S%(6,3,3)
30 FORF=1TO6:FORY=1TO3:FORX=1TO3
40 READ V:S%(F,Y,X)=V
50 NEXT:NEXT:NEXT
60 DATA1,7,5,3,9,2,4,8,6
70 DATA4,3,5,8,6,9,2,1,7
80 DATA7,8,6,9,3,1,2,4,5
90 DATA2,4,7,1,5,8,6,9,3
100 DATA5,1,3,8,4,9,7,6,2
110 DATA8,3,4,2,9,6,7,1,5
120 A$(1)="BLACK CIRCLE":A$(2)="WHITE CIRCLE":A$(3)="BLACK TRIANGLE"
130 A$(4)="WHITE TRIANGLE":A$(5)="BLACK SQUARE":A$(6)="WHITE SQUARE"
140 A$(7)="BLACK DIAMOND":A$(8)="WHITE DIAMOND":A$(9)="HEXAGON"
150 FORX=1TO9:A%(X)=X
160 FORF=1TO6
170 IFS%(F,1,2)=XORS%(F,2,1)=XORS%(F,2,3)=XORS%(F,3,2)=XTHENA%(X)=0
180 NEXTF:IFA%(X)<>0THENPRINTA$(X)" IS ACCEPTABLE"
190 NEXTX:PRINT"NO OTHER SYMBOLS ACCEPTABLE"
200 END
```

Solution to the August crossword.

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ZX81

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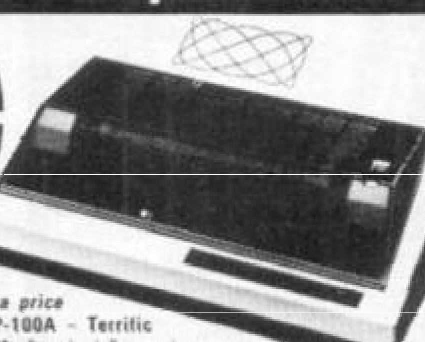
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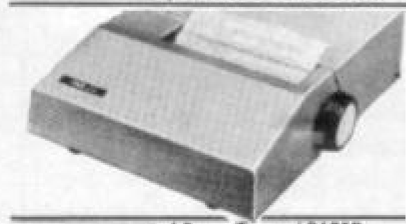
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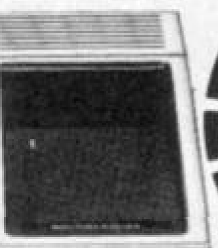
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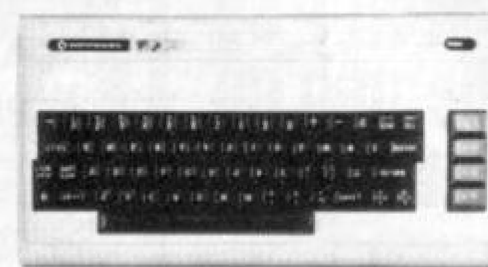
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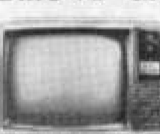
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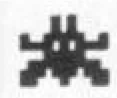
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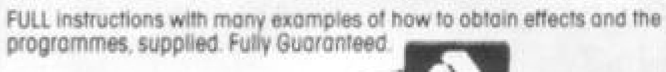
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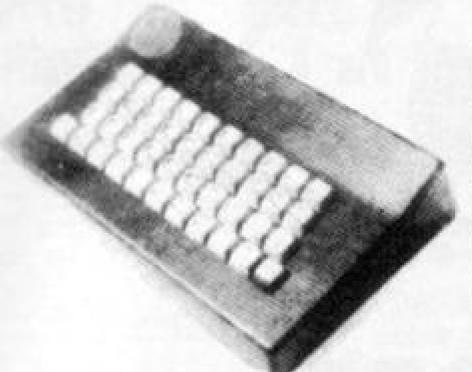
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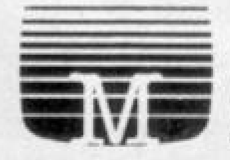
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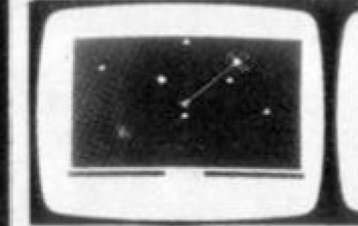
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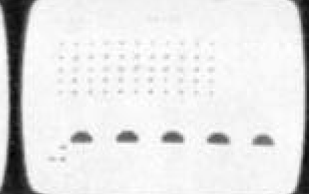
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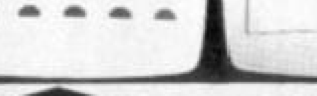
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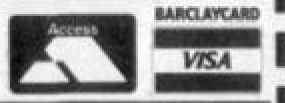
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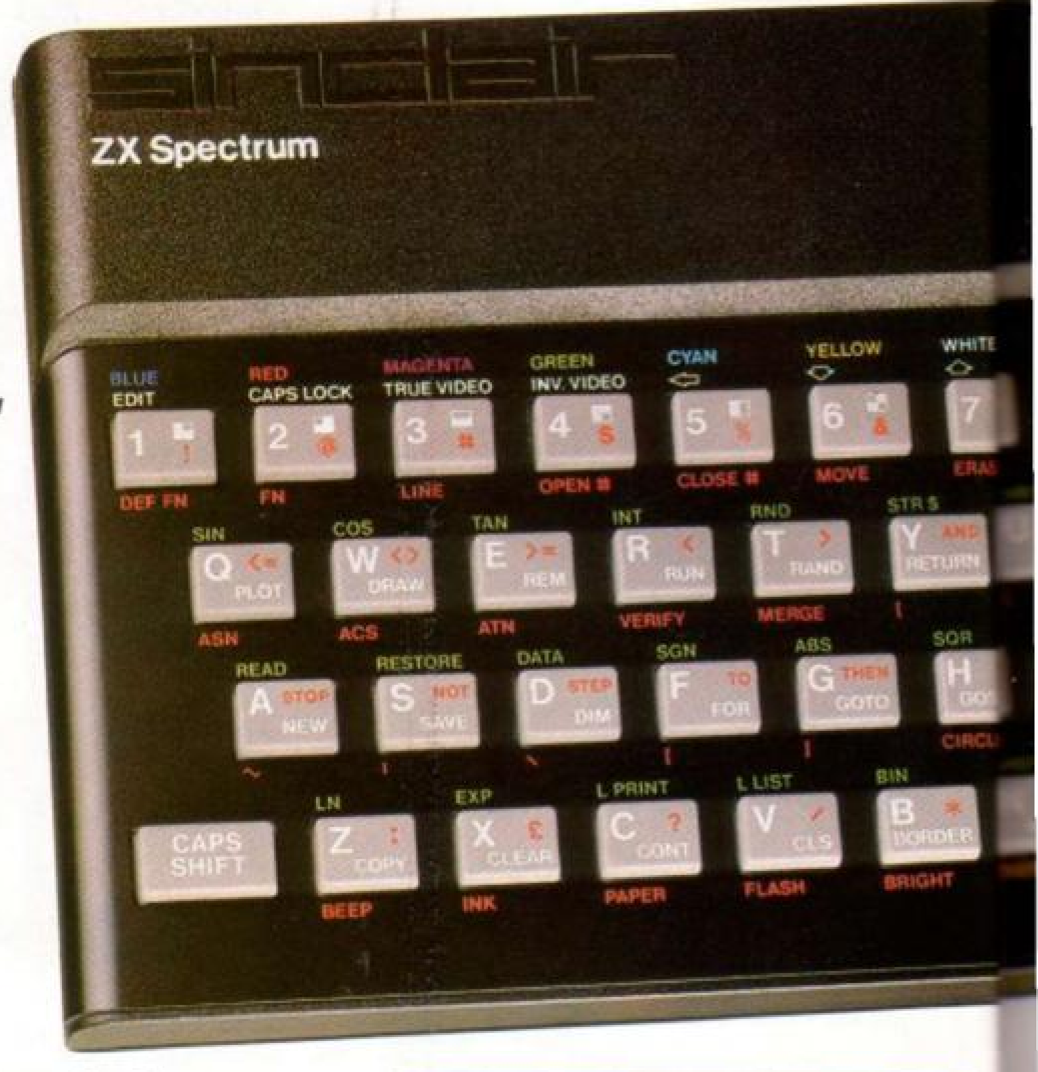


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You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer–available now–is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232/network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour–8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound–BEEP command with variable pitch and duration.
- Massive RAM–16K or 48K.
- Full-size moving-key keyboard–all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution–256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set–with upper- and lower-case characters.
- Teletext-compatible–user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE–16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC–incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

ZX Spectrum software: how good and how soon?

The ZX Spectrum uses an enhanced version of Sinclair BASIC, fast becoming a world standard, and unlikely to be superseded. Unique features, such as one-touch keyword entry and syntax check and report, are increasingly attracting software originators.

Building the software library is already far advanced, and a complete catalogue will be available in the next few months. Subjects will include sophisticated games, education, 'housekeeping', and business management. The more complex packages can, of course, be used to their best advantage with the full 48K RAM version of the ZX Spectrum.



The Sinclair ZX Spectrum can handle sophisticated games programs with high-resolution colour graphics and sound.



This major advance in computer technology maintains Britain's world-beating position in the field of personal computers.



A range of business software will soon be available, covering both specific applications (eg stock-control and payroll) and general business management systems (eg matrix models).



This second generation of Sinclair personal computers demonstrates continuing commitment. Advanced technology made the ZX80/81 family a price breakthrough: advanced technology makes the ZX Spectrum a breakthrough in price and performance.

Elegant, effective, unique—the ZX Spectrum design.

'Less than half the price of its nearest competitor – and more powerful.'

'These two pictures show how it's done. On the right is the PCB from the BBC Model A Microcomputer. On the left is the PCB from the ZX Spectrum.

'It's obvious at a glance that the design of the Spectrum is more elegant. What may not be so obvious is that it also provides more power.

'The ZX Spectrum has more usable RAM, and higher maximum RAM.

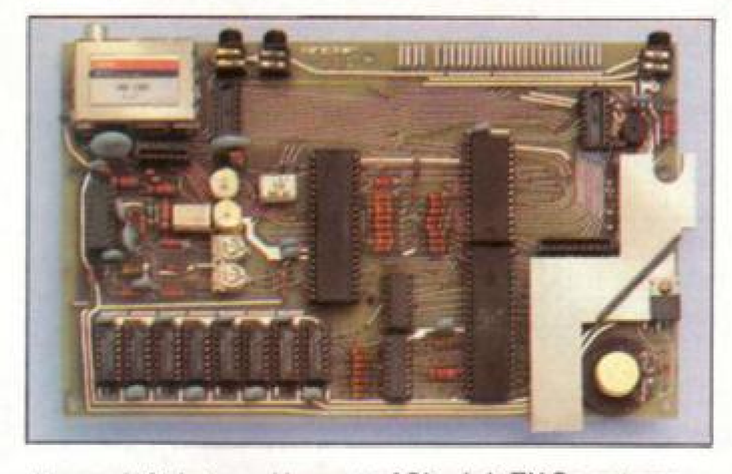
'It offers twice as many colours on the screen at any one time, plus a colour brightness control. It also offers user-definable graphics.

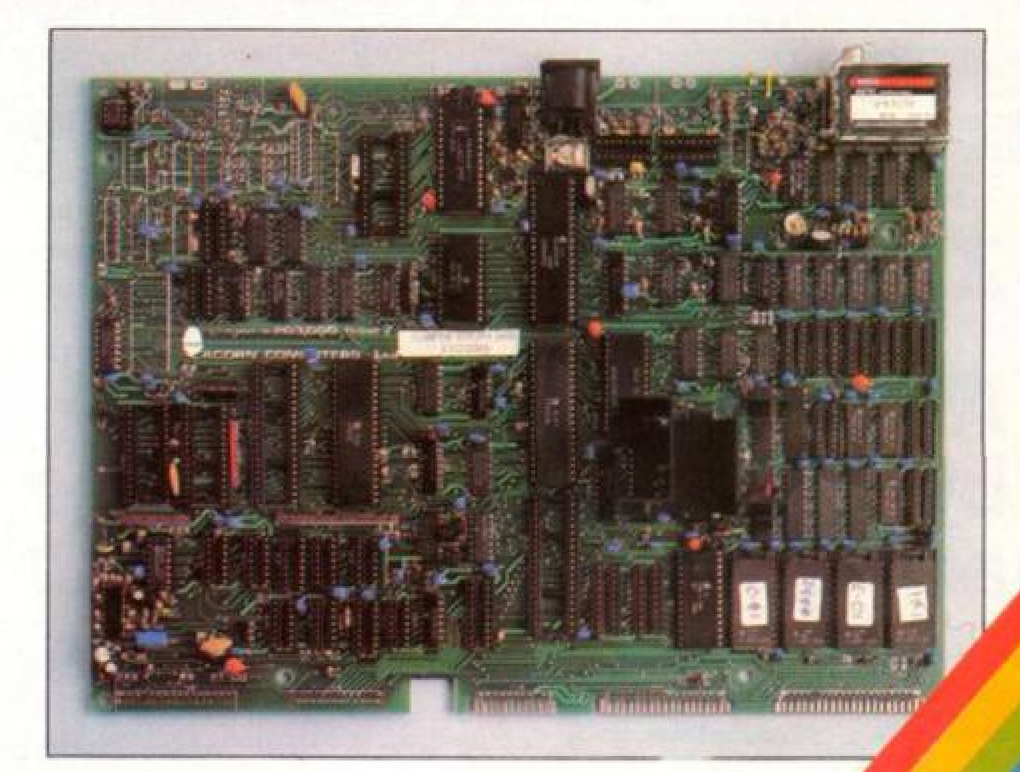
'It has data transfer rate 25% faster, supported by a VERIFY facility.

'And it employs a dialect of BASIC (Sinclair BASIC) already in use in over 500,000 computers worldwide.

'We believe the BBC make the world's best TV programmes – and that Sinclair make the world's best computers!'

– *Clive Sinclair.*





Above left: internal layout of Sinclair ZX Spectrum.

Right: Internal layout of BBC Micro Model A.

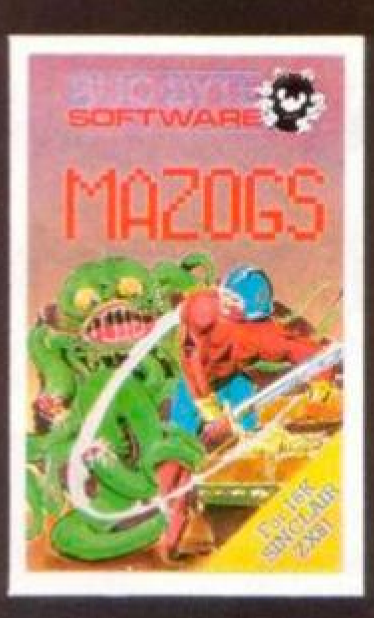
The illustrations are to the same scale, and demonstrate the rate of advance in microcomputer design. The ZX Spectrum uses just 14 chips to provide more power and more user-available RAM.

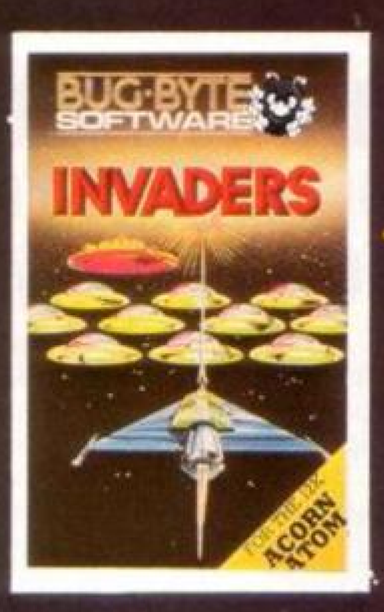
sinclair ZX Spectrum


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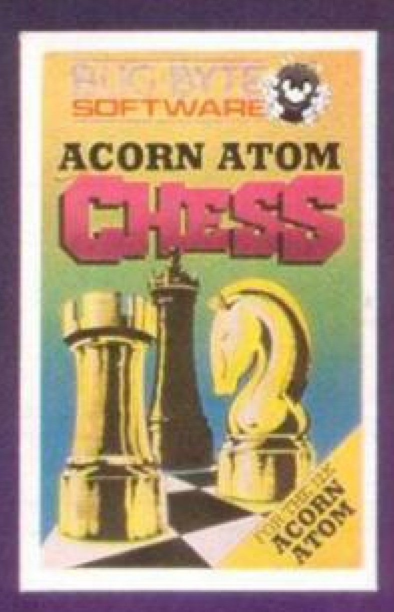


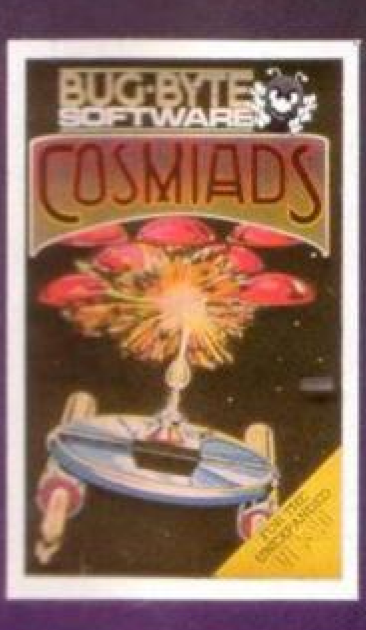


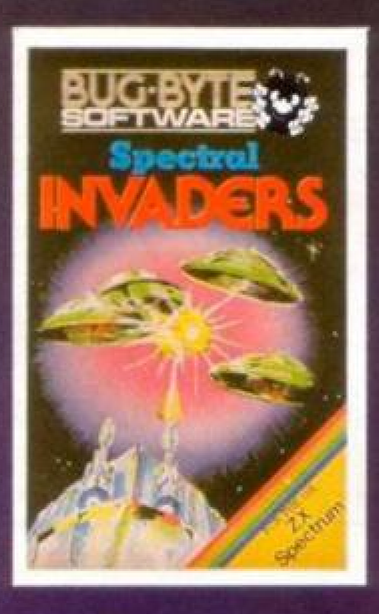


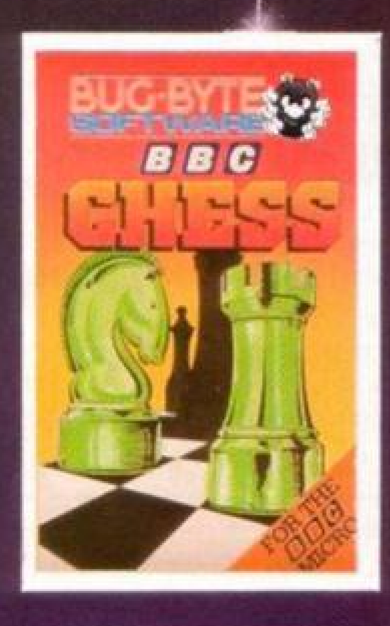


WHAT'S YOUR GAME?

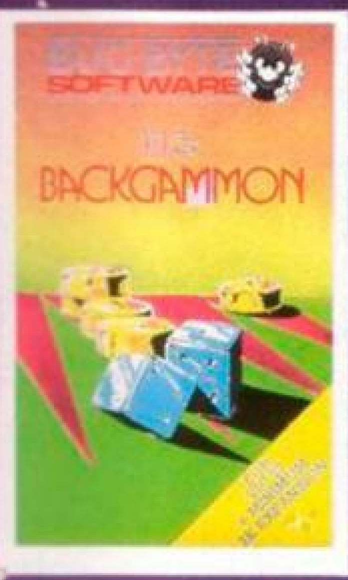




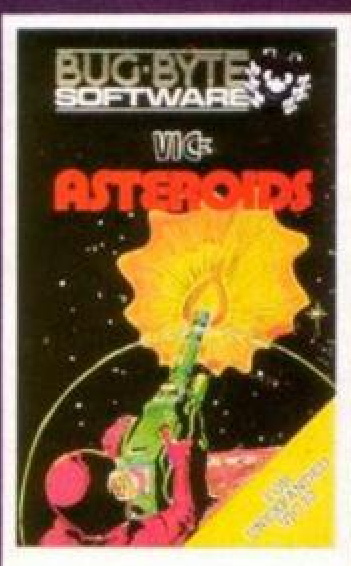












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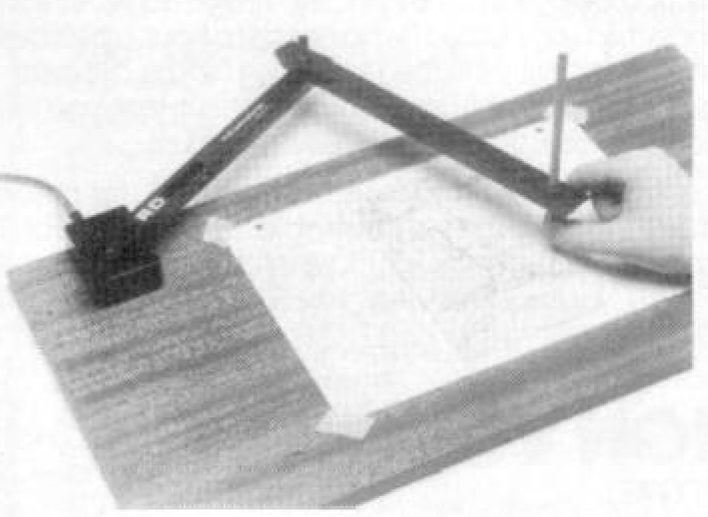
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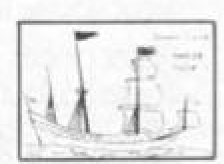
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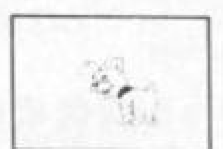
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CASSETTE 2

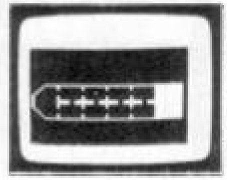
Ten games in Basic for 16K ZX81

Cassette Two contains Reversi, Awari, Laser Bases, Word Mastermind, Rectangles, Crash, Roulette, Pontoon, Penny Shoot and Gun Command.
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CASSETTE 3

8 programs for 16K ZX81

STARSHIP TROJAN



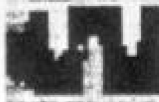
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SECRET MESSAGES This message coding program is very txlp qexi jf.
MARTIAN CRICKET A simple but addictive game (totally unlike Earth cricket) in machine code. The speed is variable, and its top speed is very fast.
Cassette 3 costs £5.

CASSETTE 4

8 games for 16K ZX81

ZX-SCRAMBLE (machine code)


Bomb and shoot your way through the fortified caves.

GUNFIGHT (machine code)



INVADERS (machine code)



GALAXY INVADERS (machine code)
Fleets of swooping and diving alien craft to fight.

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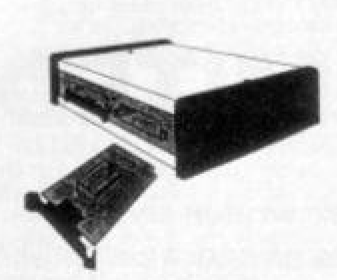
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